FLIGHT

The AIRCRAFT ENGINEER & AIRSHIPS

First Aero Weekly in the World

Founder and Editor: STANLEY SPOONER

A Journal devoted to the Interests, Practice, and Progress of Aerial Locomotion and Transport

OFFICIAL ORGAN OF THE ROYAL AERO CLUB OF THE UNITED KINGDOM

No. 896. (No. 8, Vol. XVIII.) FEBRUARY 25, 1926 [Weekly, Price 6d. Post free, 7d.

Flight

The Aircraft Engineer and Airships

Editorial Offices: 36, GREAT QUEEN STREET, KINGSWAY, W.C.2.
Telegrams: Truditur, Westcent, London. Telephone: Gerrard 1828.

Annual Subscription Rates, Post Free.

United Kingdom .. 30*s.* 4*d.* Abroad .. .. 33*s.* 0*d.**

These rates are subject to any alteration found necessary under abnormal conditions and to increases in postage rates.

* *Foreign subscriptions must be remitted in British currency.*

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EDITORIAL COMMENT.

THE Air Estimates, which in many circles of the community have caused considerable misgivings during the last two months or so, were published towards the end of last week, and the fears that had been entertained appear to have been only too well founded. For once rumour has been reasonably accurate, and the brunt of the reductions seems to have fallen on just the particular vote which should, in our opinion and that of a very large number of independent observers qualified to judge, be the last vote to be interfered with, *i.e.*, Vote 3 (Technical and Warlike Stores), and more particularly sub-head A of Vote 3 (Aeroplanes, Seaplanes, Engines and Spares). As we have repeatedly pointed out in these columns, the British aircraft industry is the foundation for our whole air defence, and to undermine that foundation is to produce a tottering structure which cannot possibly be safe, and which could certainly never "pass the A.I.D." Yet that is precisely, unless we have failed to interpret the somewhat involved estimates, what it is proposed to do. Works, buildings, lands, staffs, mechanical transport, messengers, clerks and similar "effective and non-effective" (especially the latter) services must go on whatever happens. But if the question of effecting economies arises, then let the aircraft industry be the section to suffer. The nation must buy palaces for the staffs which direct the destinies of our air defences, but the fact that if we go on in the way we have been doing there may be no air defences to direct seems to have been overlooked.

The Air Estimates

To come down to figures, Vote 3, sub-head A1, calls for the sum of £2,888,000 to be expended upon complete machines. The corresponding figure last year was £2,908,000. Apparently, therefore, the "cut" only amounts to £20,000. But it should be remembered that the aircraft industry had been led to believe that there could be no question, not only of reduction, but that a steady increase in orders might be counted upon. Under that understanding, and it was an impression which had a very good

foundation since even the Labour Government had approved of this principle, the aircraft industry prepared its plans, laid down plants for which, in less secure circumstances, there would in many cases have been no justification, carried out individual researches and experiments which many of the firms who undertook them could ill afford, carried on with but small profits, or even at a loss, always under the impression that a definite programme of steady expansion would be adhered to whatever Government happened to be in power. Now it is found that the Government from which one least expected such action has not only failed to adhere to its policy of steady increase in orders, but is actually calling for a reduction in orders. The actual "cut," as we have said, is insignificant, but the failure of the anticipated increase to materialise is vastly more serious.

Vote 3, sub-head A2, is even more unsatisfactory. This relates to complete aero engines. The figure to be voted is £1,031,000, as compared with £1,537,000 last year. *Thus, under this head alone it is proposed to "save" no less than* £506,000. At the moment there are, to all intents and purposes, but four British firms producing aero engines of types that come into consideration in the Air Estimates. The "cut," therefore, means that, if orders were evenly distributed (which, in point of fact, they are not) each firm would be "down" on orders to the extent of £126,500. Put in another way: if it is assumed that the average price of an aero engine is £2,000, the reduction means that 253 fewer engines will be purchased. Probably the actual number would be nearer 300. The same remarks about the expectation of increased orders apply to the engine firms as to the aircraft firms, so that actually the position of the four British Aero engine firms will be worse than the figures themselves indicate, which are already bad enough in all conscience.

Sub-head A3 of Vote 3, dealing with machine spares, parachutes and miscellaneous, is estimated to require £913,000, as against £859,000 the previous year. This might give the impression that the aircraft constructors will receive rather larger orders for machine spares. Even if this were so, it is unsatisfactory, since our main designing firms ought to be fully occupied producing new and improved types of machines, and not in turning out spares. Actually even this figure, which indicates an increase of £54,000, does not necessarily mean extra work for the aircraft firms. It will be noted that the sub-head includes parachutes, and it will be remembered that large numbers of these are being obtained from America, so that one is justified in assuming that a not inconsiderable proportion of the sum to be voted under this sub-head will go to foreign manufacturers.

Under sub-head A4 (engine spares) there is a reduction of £41,000, from £560,000 to £519,000, which "cut" will also have to be sustained by the aero engine firms. These will, therefore, so far from enjoying the expected increase in orders, actually sustain a loss of orders to the tune of £547,000. As we have repeatedly pointed out, it costs a great deal more to develop a new type of aero engine than it does to produce a new type of aircraft; also it takes very much longer. Now an aero engine firm is not paid for its experimental and development work, and must hope to make up the money spent in this way on orders for the completed engine. That is why the reductions to be found under sub-heads A2 and A4 must necessarily hit the aero engine firms very hard indeed, and that at a time when it is generally admitted that a great effort should be made to evolve new types of aero engines for modern conditions. Other countries are going ahead. The United States have spent a great deal of money on the production of new types of aero engines. France has just completed a long aero engine competition in which prizes to the amount of one million francs were offered. Yet we propose to cut down, not by a relatively small amount but by more than half a million sterling, the orders to our four engine firms. The outlook is, in this respect, truly serious.

We make no apology for devoting so much space to Vote 3A. It is the one vote in which we are particularly interested, and it deals with the fundamental basis of the whole British air defence. The whole of Vote 3 shows an *increase* of £441,000 in spite of the money "saved" on the really essential sub-heads of the Vote, so that the nation is merely taking away a lot of money badly needed to keep the aircraft industry alive and spending it in other directions, which are not, cannot be, anything like as fundamentally important.

Space does not allow of referring in detail to the other Votes, but by way of showing how the money is being spent it is of interest to take the gross total of the Air Estimates, £20,864,500, and see what approximate percentage of this total is being devoted to the various votes. The pay of the R.A.F. is £4,667,000, or 22 per cent.; quartering, stores, supplies and transport call for £2,268,000, or 10·8 per cent.; technical and warlike stores (including Experimental and Research Services), £8,231,000 (39·5 per cent.); works, buildings and land, £2,843,000 (13·6 per cent.); medical services, £347,500 (1·66 per cent.); educational services, £448,000 (2·15 per cent.); auxiliary and reserve forces, £406,500 (1·95 per cent.); civil aviation, £473,000 (2·27 per cent.); meteorological and miscellaneous effective services, £172,000 (0·83 per cent.); Air Ministry, £762,000 (3·65 per cent.); and non-effective services, £246,500 (1·17 per cent.).

At St. James's Palace

AT the Levee held by His Majesty the King on February 23rd at St. James's Palace, the following were amongst those present:—

Air Marshal Sir John Salmond, Principal Air Aide-de-Camp, Air Chief Marshal Sir Hugh M. Trenchard, Bart., Wing Commander J. H. S. Tyssen, Flight Lieut. G. W. Hemming, Sir Samuel Instone, Senor Col. Don Fernando Rich (Spanish Air Attaché), Lieut. de V. Bos (French Air Attaché), Major H. C. Davidson (U.S. Air Attaché), Capt. T. Toyoda (Japanese Air Attaché), Commander A. de Bahr (Swedish Air Attaché), and others. The following were presented to His Majesty the King: General A. Guidoni (Italian Air Attaché), Major Don Diego Aracena (Chilean Air Attaché—Military), Air Vice-Marshal T. I. Webb-Bowen, C.B., C.M.G., Flying Officer H. G. Brookman, Flying Officer W. N. Lancaster, Flying Officer C. G. H. Lumsden, Flight Lieut. A. McR. Moffatt, Flight Lieut. E. R. Openshaw, Mr. W. S. Smith, C.B., O.B.E., Flying Officer P. Stainer, Flight Lieut. V. H. Tait, Flight Lieut. W. W. Wakefield, etc.

Aircraft Search for Missing Seamen

IRISH Free State aeroplanes have been employed in searching amongst the lonely islands off the coast of Galway for the missing crew of the trawler "Cardigan Castle," but without success.

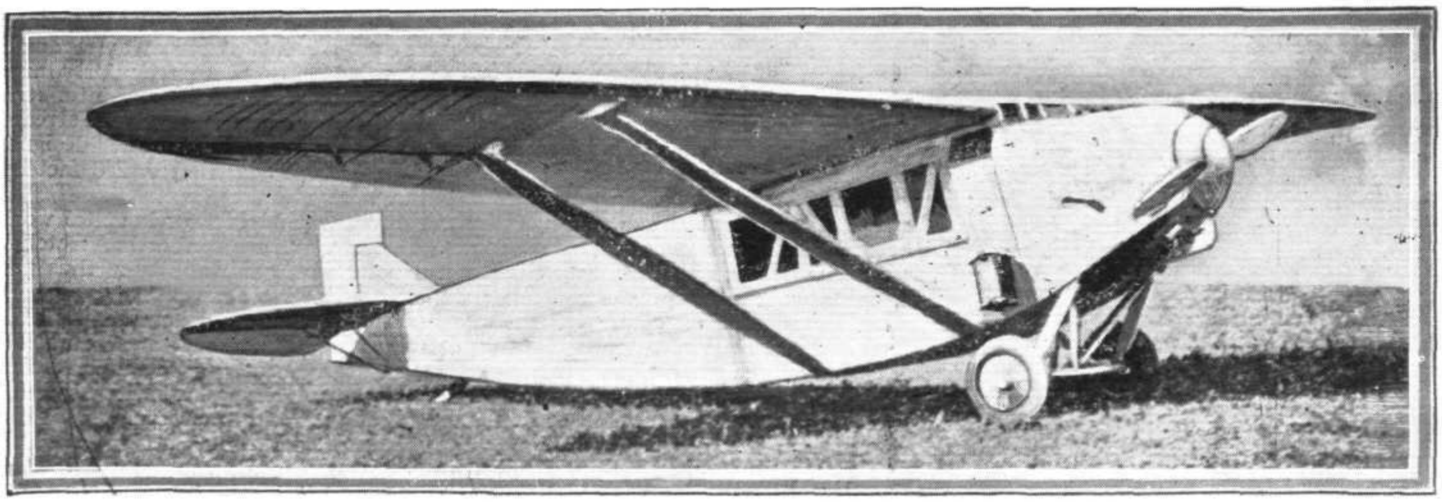
THE "K.1" MONOPLANE

A Commercial Machine Constructed in Soviet Russia

We have of late been able to give readers of Flight certain information regarding aviation in Soviet Russia, from which it will have been apparent that this country is fully aware of the importance of aviation—both commercial and military. Indeed, Soviet Russia is making a bold bid for a foremost position in the world of aeronautics.

So far, Russia has done but little as regards the design and construction—although mention should be made of the later, however, that the completed machine made its appearance as a commercial aeroplane under the title of R.W.Z.6.—K.1. K. A. Kalinin, who was a pilot himself in 1916, and who is now at the head of the Bureau of Construction, was responsible for the design of this machine.

An interesting point regarding the construction of the K.1 is the use of steel tubes, which had been in stock in connection with the Voisin machines previously used in Russia,



THE "K.1" COMMERCIAL MONOPLANE: Three-quarter front view of a passenger aeroplane built in Soviet Russia. *It is fitted with a 170 h.p.* Salmson engine.

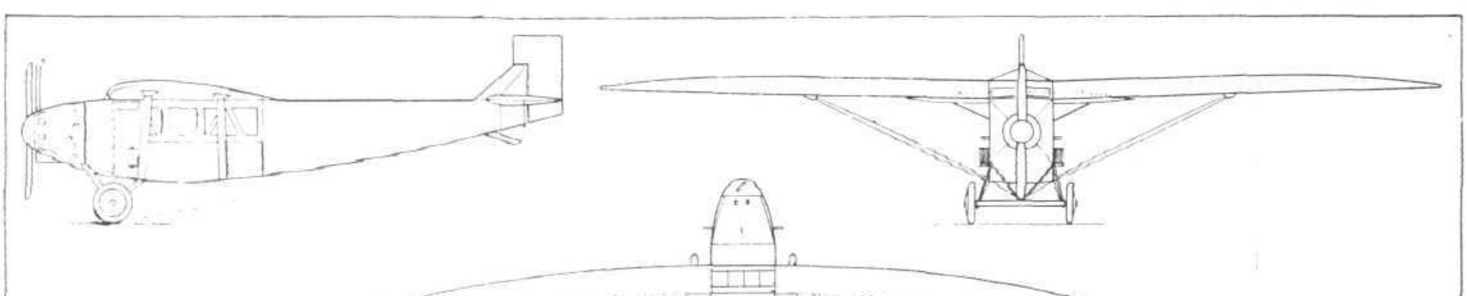
successful Russian designer, Sikorsky, who constructed, some time ago, the forerunners of the Giant multi-engined aeroplane, and who is now producing aircraft in America.

Recently, however, we learn that Soviet Russia has been giving more attention to the construction side of aeronautics, and that factories have been established where aircraft are being—or have been—constructed. We are able this week, through the courtesy of the Soviet Aircraft journal "Samolet," to give a brief description of one of these Russian-built aeroplanes—the "K.1."

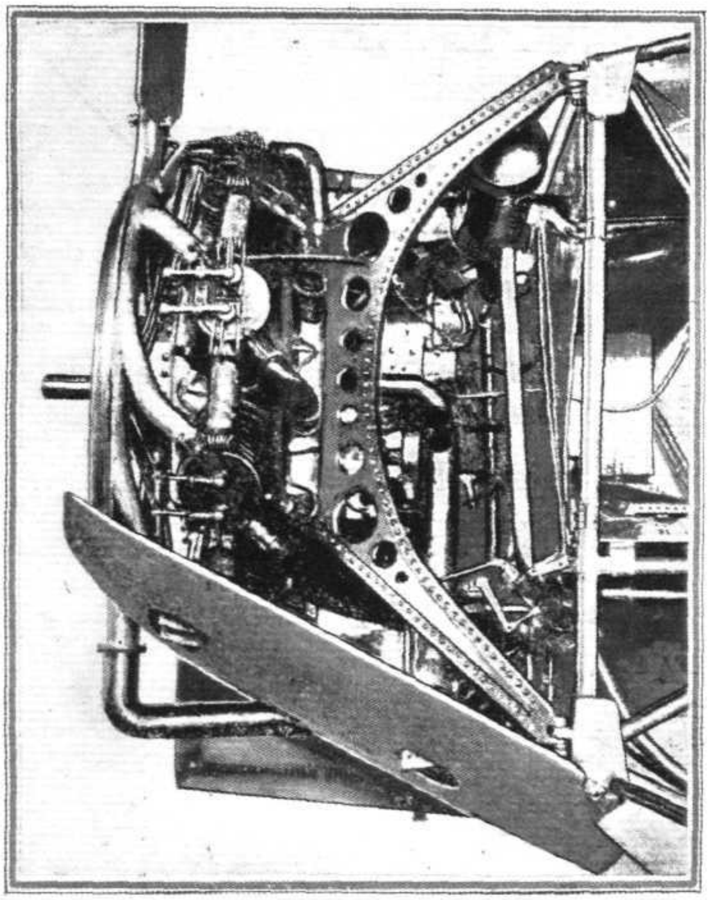
The "K.1" is a tractor high-wing monoplane of the enclosed cabin or limousine type, similar to the Dornier "Komet" monoplanes, which are employed on certain of the Russian air lines. It was originally constructed in one of the Soviet factories in 1920, under the very difficult conditions obtaining at that time. It was not until five years but since abandoned. These tubes were, of course, first tested in the laboratories and were found to be satisfactory for the purpose, and have been employed throughout in the construction of the fuselage, under-carriage and rudder. The wings and tail surfaces, however, are of wood construction. "Samolet" refers to the fact that M. Kalinin was helped considerably in the production of this machine by the workmen, who showed great interest and enthusiasm in its design.

As will be seen from the accompanying illustrations, the fuselage of the "K.1" is of deep rectangular cross-section, with enclosed cabin, provided with a door and windows, for the passengers, located immediately beneath the wings, and with an enclosed cockpit for the pilot located high up in the fuselage at the leading edge of the wings.

Communication is provided between the pilot's and passengers' compartments by means of a door. The covering



THE "K.1" COMMERCIAL MONOPLANE: General arrangement Drawings.



The detachable engine mounting on the Russian "K.1" monoplane.

of the fuselage from the engine to the rear of the cabin is sheet aluminium, while the remaining portion of the fuselage is fabric-covered.

The engine, complete with accessories, is mounted on a special frame, which is attached to the fuselage by four bolts, and it is possible to remove this frame and replace it by another frame with a spare engine installed in about half-an-hour. Or, if desired, an engine of different make can be fitted. For instance, at present a 170 h.p. Salmson engine is fitted, but provision has been made in the design for replacing this engine by one of entirely different make, such as the 185 h.p. B.M.W., for which engine a special engine frame is employed, but which is attached to the fuselage by the same four bolts.

The wings of the "K.1" form another feature, for M. Kalinin has adopted the elliptical plan form, which, although presenting certain difficulties from the production point of view, possesses good aerodynamical qualities. The wing section employed is the Prandtl No. 436.

The wings, which are set at a dihedral angle of 6°, are built up in three sections, a centre panel mounted on the top of the fuselage, and two outer panels bolted to the former. Bracing is by two pairs of steel struts streamlined by aluminium fairings extending from the lower longerons of the fuselage up to the wings. The strut attachments to the latter are faired by neat aluminium boxes.

An elliptical plan form is also employed for the horizontal tail plane and divided elevator, but the section is symmetrical. A small triangular vertical fin, to which is hinged a balanced rudder, is mounted above the horizontal tail plane. The angle of incidence of the tail plane, it should be noted, can be adjusted to meet variations of load. Wings and tail surfaces are fabric covered. Lateral balance is obtained by means of ailerons, which, it will be observed, are not particularly large.

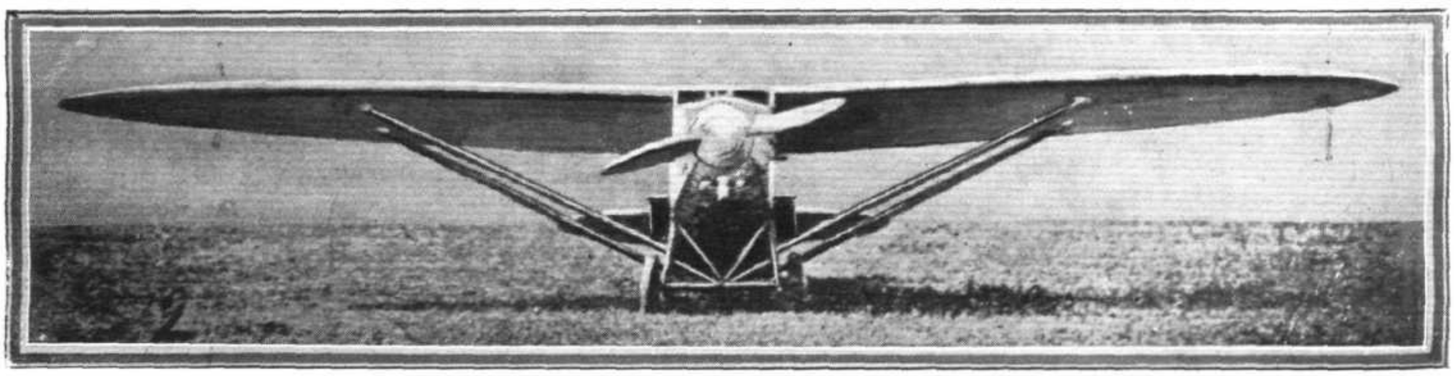
A conventional V-type undercarriage, with V-inter-strut bracing, is employed, the struts being steel tubes with streamline aluminium fairings. A special airscrew, designed by M. Kalinin and constructed in the R.W.Z.6 factory, is fitted.

If required, the "K.1" can be adapted for hospital work, the cabin being altered to accommodate three berths, stretchers and other hospital appliances. Its adaptability is thus particularly suitable for the conditions in Russia.

The "K.1"—which is the first machine employing steel tube construction to be produced in Russia—was completed in July, 1925, and on the 26th of that month made its first trial flight, piloted by the work's chief pilot, Kossinsky, with satisfactory results. In September the first flight with passengers was made to Moskva, via Charkov. The 430 kms. (266·6 miles) to Charkov was accomplished in 2 hrs. 45 mins. at an average speed of 156 k.p.h. (96·7 m.p.h.), and the 390 kms. (242 miles) to Orel in 2 hrs. 55 mins. The remaining 380 kms. (235·6 miles) to Moskva, against a strong headwind, took, also, 2 hrs. 55 mins. This was in the nature of its official trial, and after further various trials under a special commission, it was found to answer all requirements, and was therefore passed on for service on the civilian air lines.

The principal characteristics of the "K.1" are:—

Span	16·76 m. (55 ft. 0 ins.).
Chord	3·50 m. (11 ft. 5 ins.).
O.A. length	10·72 m. (35 ft. 2 ins.).
Wing area	40 sq. m. (430·4 sq. ft.).
Weight laden (approx.)	2,000 kgs. (4,400 lbs.).
Wing loading ..	49·3 kgs./m² (10·1 lbs./sq. ft.).
Power loading ..	12·3 kgs./h.p. (27 lbs./h.p.).
Speed range	60-160 k.p.h. (37-99 m.p.h.).
Climb in 12 mins. ..	1,000 m. (3,280 ft.).
Ceiling..	3,000 m. (9,840 ft.).
Gliding angle	1 in 9·2.
Pull-up in landing ..	100-120 m. (328-373 ft.).



THE "K.1" COMMERCIAL MONOPLANE: Front view of the Russian-built machine, the first to be produced in that country employing tubular steel construction.

A Canadian Air Service

THE Ontario Government has arranged for the establishment, through private contractors, of an aeroplane service from Hudson station, on the Trans-Continental Railway, to the new Red Lake (Ontario) gold area.

Another Brussels-Congo Flight?

THE Belgian pilot, Lieut. Medaets, is shortly to undertake a second flight from Brussels to Kinshasa, in Belgian Congo, and back. The Belgian Cabinet has agreed to provide 100,000 fr. towards the expenses of the expedition. This time a different route will be followed, for, instead of flying *via* Morocco and across the Sheard, the Nile Valley route will be taken as far as Kenya, thence westward through Belgian Congo, a total distance of nearly 6,000 miles. Incidentally, it may be mentioned that the remaining portion of the Kinshasa—Elizabethville air line (operated with Handley Page machines) was opened on February 12.

The Royal Aero Club of the United Kingdom

OFFICIAL NOTICES TO MEMBERS

COMMITTEE MEETING

A meeting of the committee was held on Wednesday, February 17, 1926, when there were present: Lieut.-Col. F. K. McClean, A.F.C. (in the chair), Ernest C. Bucknall, Lieut.-Col. M. O. Darby, Wing-Commander T. O'B. Hubbard, M.C., Lieut.-Col. M. O'Gorman, C.B., F. Handley Page, T. O. M. Sopwith, and the Secretary.

Election of Members.—The following new members were elected:—

Pilot Officer Theodore Newman McEvoy.
Sqdn.-Ldr. Harry Stewart.
Pilot Officer Geoffrey Luis Worthington.
Flying Officer Cecil James Pooley.
Flight-Lieut. Alfred Montague Blake.
Sqdn.-Ldr. James Milne Robb.
Flying Officer St. John Fitzgerald Wintour.
Sir John Phillips Rhodes, Bart., D.S.O.
William Allen.
Alan Bruce Hamilton Youell.
Alan Goodfellow.
Edward Cyril Bowyer.
Walter Theodore William Ballantyne.
Flying Officer Godfrey Webster Dean.
Flight-Lieut. Stanley Miles Park.
James Alfred McKelvie.
Flight-Lieut. Martin George McLeary Cahill-Byrne.
Edwin John Dilnutt.
David Leonard Hollis Williams.

Reports from Committees.—Reports from the House and Finance Committees were received and adopted.

Britannia Trophy.—It was unanimously decided to award the Britannia Trophy for the year 1925 to Mr. A. J. Cobham, whose flight with Air Vice-Marshal Sir Sefton Brancker from London to Rangoon (Burma) and back was considered the most meritorious performance by a British aviator during the year. Mr. Cobham left London on November 20, 1924, and arrived back on March 17, 1925. The machine was a D.H.50, with 230 h.p. Siddeley Puma engine.

Private Flying.—Mr. F. Handley Page presented the report of the Sub-Committee on Private Flying. The report was adopted, and it was decided that the Sub-committee—F. Handley Page, Lieut.-Col. M. O. Darby, Maj. Hemming, Sqdn.-Ldr. M. E. A. Wright, and H. E. Perrin—should represent the Royal Aero Club at the Air Ministry Conference.

Gift of £1,000 for Light Aeroplane Clubs.—The Secretary reported that he had attended a meeting of the Petroleum Distributors' Committee, when they had handed to him on behalf of the Anglo-American Oil Co., Ltd., British Petroleum Co., Ltd., Redline Motor Spirit Co., Ltd., and Shell-Mex, Ltd., a cheque for £1,000, to be applied for the purpose of encouraging light aeroplane clubs under the Air Ministry scheme.

It was unanimously decided that a letter of thanks be sent to the Petroleum Distributors' Committee.

Aviator's Certificate.—The following aviator's certificate was granted:—

7981. William Thomas Walton, Junr. January 19, 1926.

Appointment of Timekeepers.—The following official timekeepers were appointed for 1926: A. G. Reynolds; A. V. Ebblewhite; Col. F. Lindsay Lloyd, C.M.G., C.B.E.; F. T. Bidlake.

Offices: THE ROYAL AERO CLUB,
3, CLIFFORD STREET, LONDON, W. 1.
H. E. PERRIN, Secretary

PRIVATE FLYING

Discussion at Royal Aero Club Dinner

"Private Flying" was the subject under discussion at the fourth monthly house dinner of the Royal Aero Club held on Wednesday of last week, February 17. As on previous occasions, the dining room was filled to the limits of its capacity, and we learn that very large numbers of applications for seats had to be refused because of lack of space. Readers wishing to make sure of being able to attend the next dinner should keep this in mind, and should apply for seats early in order to avoid disappointment.

His Grace the Duke of Sutherland was in the chair, and before opening the debate, he stated that since last he attended one of these functions he had travelled some 8,000 miles. During his trip he had had an opportunity of seeing some of the work of the French air service, and at Casablanca he had the good fortune to meet the Spanish fliers who were then on their way to South America, a very meritorious journey, which had since been successfully completed. Before calling on Capt. Courtney to open the debate, His Grace said he must ask speakers taking part in the discussion to confine themselves, as far as possible, to a period of five minutes each, as it was hoped many would wish to speak and there would not be time for long speeches.

Capt. F. T. Courtney said he was faced with the difficulty of having to rely upon some notes which he could not read, and which dealt with something that did not exist. He had been a private aeroplane owner for three years, and in that time, owing to all the various restrictions he had flown his machine *once*. When the present regulations were drawn up they were intended to protect flying and also to protect the general public. Nowadays he thought the main idea was to slack off the regulations a bit so as to allow private flying to start. Flying had to be made safe, and the best way to make it so was to get in as many flying hours as possible, thus learning from experience where to look for trouble. The present regulations should be removed and the whole question should be reconsidered in the light of modern conditions.

He would divide the regulations into two classes, the essential and the unessential. Among the former he would include registration and licensing. Heavy penalties should be imposed for transgression. On the question of the rules of the air an examination was, he thought, essential. Otherwise, when we got large numbers of machines flying there was risk of trouble. With the medical examination he had no patience. It did not matter whether a man who intended to become a private owner suffered from certain drawbacks, such as near-sightedness, if he was able to make good landings. A competency test of actual flying skill would tell them all they wanted to know about the private owner, and he thought the medical examination entirely superfluous. As regards the question of third party risks, he suggested that insurance might be carried out on club lines.

Turning to what he termed the unessentials, Capt. Courtney devoted a good deal of time to the question of the Certificate of Airworthiness. The view had been advanced that the constructors of the machine should issue the C. of A. With that view he did not agree, since the owner might damage his machine during use, and it would be unfair to expect the constructor to take the responsibility. On the subject of the investigation of accidents, he failed to see why such an investigation was necessary. At present, if a man damaged his fuselage in landing, he was not permitted to remove the machine until sundry officials had examined it. If a man bent the front axle of his motor-car he was not expected to leave the car in the road. He simply found out where the nearest garage was and made arrangements to have the car taken there. As regards third party risk, a car was infinitely more dangerous than an aeroplane.

Dr. Whitehead Reid, who has been a private owner of aeroplanes for a number of years, and has used them for pleasure flying, said what we had to do was to encourage people to fly for amusement. Popularisation of flying was most important, and in order to do that it was essential to

demonstrate that flying was not risky, nor difficult. He would suggest that the Air Ministry should send out propaganda pilots on "Moths," for instance, to take up people and let them handle the controls so as to demonstrate how easy it was to fly an aeroplane. He did not suggest that one should let them land the machine. (Laughter.) It would not cost a great deal to send a couple of dozen "Moths" around to seaside resorts to take up people for nothing.

One stumbling block to private flying was the cost. This was high because so few machines were produced, and could only be reduced if there was a large demand. He thought a fairly easy medical test should be asked for and also a small flying test. With regard to accidents, he suggested that a lot of useful information could be disseminated if the Air Ministry were to issue the results of accidents investigations on some of the beautiful little green papers to all owners of aeroplanes. Insurance was a serious problem. Hitherto the fees had been high, but they were now becoming more reasonable.

Major Mayo agreed with Capt. Courtney that the present restrictions should be removed, but he did not agree that some should remain. He personally would like to see *every* restriction removed, and proceeded to show the absence of need for restrictions by drawing comparisons with the driving of motor-cars. Here there was no medical examination, yet the number of unfit persons who took out licences was very small. Those who were dangerous on the roads were not the deaf and blind and dumb, but the road hogs. The same would apply in the air. There appeared to be something to be said for the rules of the air examination, but the same result could be attained without imposing an examination, namely, by penalties for violating the regulations, as was done on the road. The same with flying tests. No test was demanded from a driver of a car, and none should be demanded from a pilot. Accidents on the roads were not due to inexperienced drivers, but to reckless drivers. He would like to see the removal of the C. of A. and of the periodic inspection. This was in no way a criticism of the manner in which the present regulations were being handled by the A.I.D., who were bound by the system.

Flight-Lieut. Soden (who has used an Austin "Whippet" for private touring for years) expressed himself in favour of "washing out" the restrictions as applied to private flying, at any rate for a year or so, until they saw what the effect was. After that period the position might have to be considered. The trouble with private flying was that at the moment there was not a machine in the country which a man could afford to buy. Why, he asked, should a de Havilland "Moth" cost £885? Unless they could bring the cost down they might as well "pack up." On the vexed question of the C. of A. and inspection, etc., the Air Ministry restrictions should be removed. Surely by now a few of our constructors should know how to build machines that did not fall to pieces in the air. The Air Ministry should order machines in batches so as to enable constructors to bring the price down.

Capt. Goodman Crouch said he was somewhat amused at Capt. Courtney's statement that he had owned a machine for three years and had only flown it once. As the C. of A. was issued to Courtney nearly three years ago, his failure to fly the machine more often could scarcely be blamed on the C. of A. As regards the suggested relaxation of the present restrictions, he thought they *could* get ahead, especially in the manner in which they put the question: Is this machine safe? The trouble at present was not so much with the restrictions as with the manner in which they were applied. As an instance he quoted the example of a machine which had been passed for flying, and was standing on the aerodrome ready to go up. The aerodrome at the time was covered in snow and as there was some likelihood of the wheels sinking in the constructor wished to substitute larger wheels. The Air Ministry representative, who incidentally was from his (Capt. Crouch's) department, refused to sanction the substitution, because on the drawings by which he had passed the machine the smaller wheels were specified. Now that official was perfectly right. Under the regulations he was *not* entitled to sanction the exchange of wheels, although it would have been perfectly safe to do so. Consequently the machine could not be flown. The fault was not with the man but with the system. The man should be given a certain amount of latitude in using his discretion.

As to the C. of A., he did not see why certain firms should not be approved by the Air Ministry to build and inspect their own machines. One thing he would like to plead for in connection with the forthcoming meeting between the Air Ministry and the Royal Aero Club to discuss the regulations governing private flying, and that was that they should, before approaching the Under Secretary of State for Air, attempt to reach a unanimous decision as to what they really did want. Unless they were agreed it was obviously very difficult indeed for the Under Secretary to decide.

In conclusion he asked permission to touch upon a point which was not under discussion that evening, but which he thought would be of interest. Concerning the load factors to be used on the machines built for this year's light 'plane competitions, an official announcement might be expected shortly, but in the meantime he had been permitted to state that the factors applying to machines requiring an aerobatic's certificate would be suggested, but modifications would be permitted. In this way they thought a sufficient safeguard as to strength would be achieved. The actual factors would depend upon speed. For 80 m.p.h. machines they would be 6 and 4, with 2 for diving. For higher speeds the factors would be correspondingly higher.

Capt. Geoffrey de Havilland said he had a lot of notes, but most of them did not seem to apply. From the constructors' point of view, the suggested modifications in the regulations boiled down to the question of the C. of A. There was a certain tendency at present to treat constructors as fools, and as being somewhat dishonest. That should be remedied. It should be made quite clear, he said, that he was not blaming individuals or officials. It was the system that was at fault. Altogether there had been too much Government interference with constructors, and he very much doubted whether the present standard of excellence of motor-cars would have been attained under Government control. Constructional firms were quite willing to undertake the responsibility for their machines, and one result of absence of official interference would be a reduction of something like 20 per cent. in the cost of machines.

Mr. Geoffrey Dorman said he had recently bought a motor-car, a very modest one, it was true, but still a motor car, and his experience had been that it required infinitely greater skill to drive a car on tram lines than to pilot an aeroplane. During the last few weeks he had crashed into several tram cars, omnibuses and pedestrians, and nothing as terrifying as that had ever happened to him in the air. Personally he would very much like to see the whole position reversed, applying all the present aircraft restrictions to motor cars, and the air relieved of all restrictions.

Flight-Lieut. Boyes thought the cost was the main snag. The first cost was high, partly on account of Government inspection. Insurance was high because the insurance companies had hitherto had very little data to go upon. Upkeep costs were high, mainly due to landing fees and housing charges. The actual running costs were not excessively high. He suggested that a great deal of assistance would be given if the Government were to throw open all licensed aerodromes to private owners free of charge. Private aerodrome owners might help by throwing open their aerodromes for a year or so free of charge, until things got going. He agreed with Capt. Courtney that the competency tests would do all that was necessary, no medical examination being required. The responsibility for the C. of A. should be on the constructors, and their inspectors should examine the machines after about 100 hours' flying or once a year in case of a machine that had been but little used. At the same time, he thought owners should have the right, did they so wish, to call in official inspectors, whose decision should be final. This precaution, Lieut. Boyes said, might be necessary later when construction firms might come into existence which were less conscientious than existing ones.

Lieut R. L. Preston also referred to cost as being the main obstacle, and made the suggestion that something might be done in the way of popularising private flying if a firm like A.D.C. Aircraft, Ltd., who, he understood, held large stocks of aeroplanes and engines, were to make some arrangement to hire them out at very low rates, provided those who wished to fly them undertook the payment of the insurance. Mr. Preston then briefly referred to the formation that day of the Private Owners' Club, which had ten members, all of whom owned aeroplanes. Fuller particulars of the formation of this club will be found elsewhere in this issue of FLIGHT.

Capt. F. L. Barnard considered the Private Owners' Club a somewhat curious affair, and said he was irresistably reminded of the ten little nigger boys. He said it seemed to him that the discussion had been going round in a form of vicious circle. Machines were expensive because so few were being manufactured, and the reason why so few were being built was that the machines were expensive. He thought the present restrictions might be removed, at any rate by way of a sort of trial run. Capt. Barnard thought that one fact seemed to have been overlooked in the discussion, viz., that there might be various classes of private owners. There was the young man of thirty or so, who would doubtless like

to buy sporting aeroplanes much as he now bought small sporting cars, or motor-cycles. There were, however, others who could afford to buy machines and to employ a pilot to fly them, and he had often been asked by passengers on the London air lines whether suitable machines for this purpose existed. He was aware that machines had been built which were intended to meet such a demand, but he still thought that the right kind of machine had not yet been produced for this purpose. To him it seemed that what was wanted was an enclosed machine, in which both the pilot and other occupants were protected against the wind, and as it was important to give a good view it seemed to him that what was wanted was a small twin-engined machine, possibly fitted with a couple of Siddeley-Lynx engines.

As to the suggestion that had been made by Dr. Whitehead Reid that free flights should be given in order to popularise flying, he would remind them that while joy rides were being carried out at five shillings a time there were queues of about 300 people waiting to go up, and he wondered what would happen if the flights were made free. Personally, he would rather see an attempt to popularise joy riding with much larger machines, carrying ten or twenty people at a time.

Colonel Edwards, of the Air Ministry, said he was greatly honoured by having been invited to the dinner, but he had not been able to enjoy the excellent dinner as well as he might have done, because he had been told at the Air Ministry that he was being sent to the dinner to be shot at. He did not quite see the objections to the medical examination, which was no more severe than that required when one wanted to take out an insurance policy. On the important subject of the certificate of airworthiness. he really could not see why this was necessary for private machines. In the past it had been necessary because if a number of accidents had happened in the earlier days of civil flying there would have been a great risk of frightening away the public. So far from considering that placing the responsibility for the machine on the constructors by removing the present C. of A., he thought machines would be infinitely safer. At present the constructors were building to Air Ministry specifications, and if anything went wrong the constructors would very rightly disclaim responsibility, which would rest with the Air Ministry.

Col. Edwards said a good deal had been made of the cost of flying. He had been looking up some figures, and found that for a pilot the cost during the first year varied from £7 3*s*. to £8 9*s*., and in subsequent years the cost was about £5 10*s*. which figures could not be considered high. As regards the cost of housing, the fee was £2 10*s*. per month. He had that day ascertained that the cost of housing a Wolseley car of 20 h.p. was £2 15*s*. per month, so that the charges for aeroplanes could not be considered prohibitive. The reason for the high cost of private aeroplanes at the present moment was that they were being built in ones, twos and threes, and he pointed out that if Mr. Ford was building his cars in that way each car would probably cost thousands of pounds. Col. Edwards did not see much prospect of a great increase in private flying even if all restrictions were removed. It was a matter of L.S.D., and one could not suddenly push crowds of people into the air. The increase in numbers would have to come in the form of natural evolution.

Capt. Fitzmaurice, of the Irish Free State Air Force, delighted the audience by his charming Irish manner and style. The main points of his argument were that they should remove all red tape (which incidentally was called green tape in Ireland). He thought they could with advantage copy the famous Irish attitude of first asking " Phwat is the Government ? " and having been told that, the reply was " I am agin it." He failed to see why any restrictions were necessary except possibly such as would prevent a lunatic from building a machine and crashing it in Piccadilly Circus or some such place. What they had to do above all else was to make the Empire a flying empire.

Major Dennison, of the Midland Aero Club, did not quite agree with the suggestion to remove all restrictions. He was in favour of retaining the medical examination and also the registration of private aircraft. As regards joy rides and the risk of having enormous queues waiting, he thought the light aeroplane clubs could help a great deal in this matter by arranging for a voucher system for free passengers. Concerning the question of cost, their experience so far had been that the running costs did not seem particularly high, but it was the cost of machines that was too high, and without Air Ministry assistance the outlook as to being able to purchase new machines was not very bright. The cost must come down, and the 20 per cent. reduction which Capt. de Havilland had stated to be possible by removing the present restrictions in the way of C. of A. and inspection, would not anything like meet the case. Housing was not serious, and a charge of 12 shillings per week for garaging a machine could not be considered excessive. The question of insurance was serious, and the premiums must come down. He thought the suggestion that licensed aerodromes should be thrown open to private owners free of charge a very excellent one, and would help very greatly to encourage inter-club flying, which was a phase of flying likely to do much to popularise private aviation.

Colonel Outram, of the Air Ministry, in referring to the question of inspection during construction, said that already every aircraft firm was approved to do its own inspection, and the A.I.D. merely stood by and watched them doing it. On the question of C. of A. he would remind them that in this connection there was a snag in that at present the insurance companies refused to insure machines until they had got their C. of A. What would happen in that case to privately built machines which had no C. of A. ? To bring down the cost he thought it would be essential that some kind of organisation should be established for ordering machines in quantities. Colonel Outram then referred to the question of the lunatic building and flying his own machine, which had been raised by several speakers. His Department had during the last few years had to consider several times this question of letting lunatics fly. In some cases permission had been refused, but in other cases it had been granted, and among the latter the percentage who crashed was very large indeed. To illustrate that it was not altogether a question of a man being an absolute lunatic, Colonel Outram related a case of certain fittings on an Avro having been found weak. New fittings were designed and all owners of Avro machines were notified that this change must take place. All Avro owners were traced except one, who kept on eluding them, but whom finally quite accidentally, Colonel Outram ran to earth in a field in Essex. Without telling the owner of this Avro who he was, Col. Outram, as he expressed it, " Had five shillings' worth " with this pilot, and after coming down he began to ask questions as to why the tail plane fitting had not been changed. The pilot said he was not aware that it had to be changed. although he had had a communication from the Air Ministry about a certain modification, but as he had no drawings of his machine he did not know which part was referred to, and anyway he was not going to trouble to find out. Now the point of this story was that the two fittings required for the tail plane would not have cost more than about ten shillings.

Mr. Handley Page, in one of the wittiest and most amusing speeches he has ever made, kept the party vastly delighted for a considerable time. Unfortunately it is not possible to do justice to Mr. Handley Page's amusing speech, which consisted partly of quotations from the Bible and partly of a satirical defence of the Air Ministry, on whose behalf Mr. Handley Page pretended to be speaking. He finished up by imploring the audience (still speaking on behalf of the Air Ministry) to regard that magnificent edifice that had been built in Kingsway, the miles of corridors and the thousands of offices with large staffs. Was not that a sign of real solid progress ? And yet it was suggested to sweep away with one fell swoop the whole of that magnificent organisation and the whole of that basis upon which the church of aviation. rested.

Colonel McClean proposed a vote of thanks to the Chairman, His Grace the Duke of Sutherland, and the evening came to a close with a few remarks by the Chairman.

Spanish-American Republics for Aeronautical Congress

THE Spanish Government has issued invitations to the Spanish-American Republics to attend an aeronautical congress which will be held in Madrid next October.

The Spanish Transatlantic Flight: Another British Contribution

WE now learn that Comandante Franco was aided by yet another British " Accessory " in his remarkable flight from Spain to South America—for the famous Wakefield " Castrol " oil formed part of the " Lion's " diet. It is reported that the Dornier-Wal " Ne Plus Ultra " has been presented to Argentina by the Spanish Government, so that it would seem that Comandante Franco's adventure is, for the present, at an end.

Air Survey Work in Malay

MR. RONALD KEMP, Managing Director of the Air Survey Co., Ltd., has recently secured a contract for aerial survey work from the Government of the Federated Malay States. The work will start on the completion of the contract with the Sarawak Government, which is just about to commence. We understand that Mr. Kemp will be paying a short visit to England at the end of April.

THE LONDON-CAPE TOWN SURVEY FLIGHT

Alan Cobham Completes His Task

MR. ALAN J. COBHAM, who, with Mr. A. B. Elliott as engineer and Mr. B. W. G. Emmott as cinematographer, set out from Croydon on November 16 in a D.H.50.J (Siddeley "Jaguar"), with the object of carrying out an aerial survey of the route from London to Cape Town, brought his mission to a successful conclusion last week. Thus, for the second time, has the journey from London, across Africa from north to south, to the Cape been accomplished by air—the first occasion being when Wing-Commander Sir H. A. Van Ryneveld and Squadron-Leader Sir C. J. Q. Brand made the trip in 1920.

Mr. Cobham reached Cape Town on the evening of February 17, having left Bloemfontein that morning and halting at Beaufort West *en route*. Needless to say, his reception was a remarkable one, there being thousands of spectators present, whilst Parliament had suspended its sitting that afternoon in order that members might welcome the three aviators.

The following day they were entertained at luncheon by the Civic Authorities, at which there was a distinguished gathering. The Government was represented by Dr. Malan (Minister of the Interior), and Mr. Boydell (Minister of Defence) proposed the toast of the airmen. Mr. Cobham, in responding, said that the actual flying was the most restful part of the trip. He thought that the greatest opening for civil aviation in South Africa was the development of the light aeroplane in the hands of the private owner. In South Africa they had vast distances and tremendous isolation—disastrous as far as farmers were concerned—and salvation in this matter lay in the light aeroplane.

THE LONDON-CAPE TOWN SURVEY FLIGHT: Mr. Alan J. Cobham (left), Mr. B. W. G. Emmott, the cinematographer (centre), and Mr. A. B. Elliott, the engineer (right)—and the D.H.50.J Siddeley "Jaguar" combination—who arrived safely in Cape Town on February 17

It is stated that after thorough overhauls have been effected, Mr. Cobham intends to start on his return flight this week, and he hopes to make the complete journey in record time.

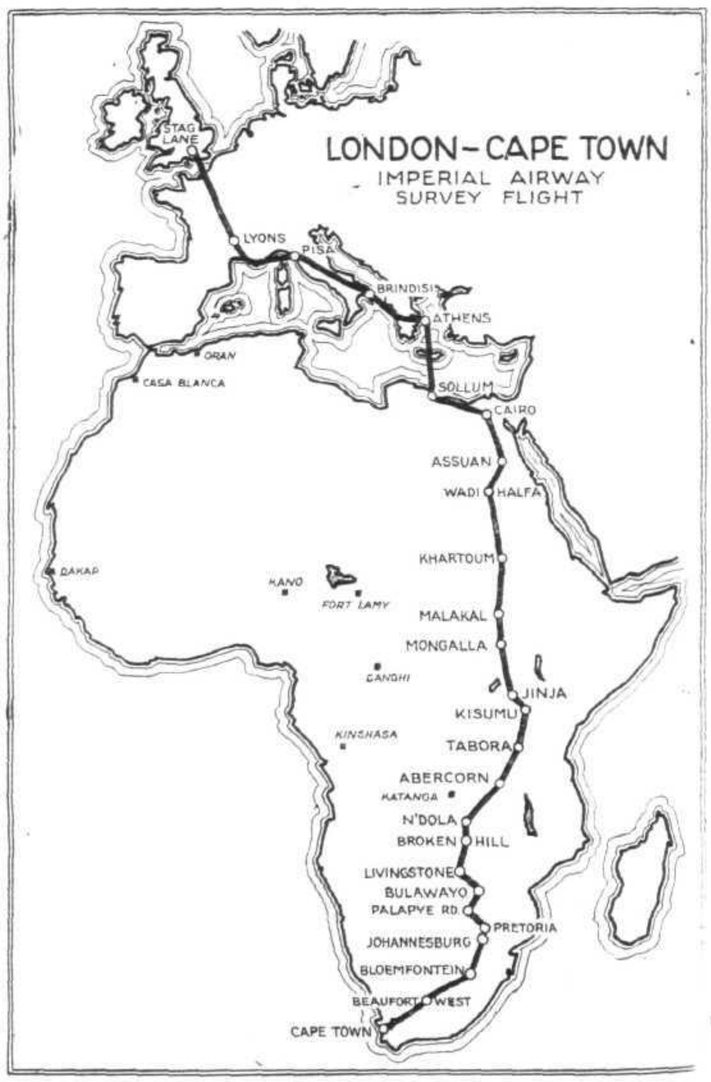
While the outward journey has occupied a total time of four months, it must be remembered that no attempt was made at covering the 8,020 miles (this is the scheduled distance, actually it is more) in record time, for the sole object of the flight was to survey, as thoroughly as possible, the London-Cape Town route, and to consult or advise various interested parties *en route* on the subject of commercial air services. In fact, in this respect we are given to understand that Mr. Cobham has accomplished a considerable amount of spade work, both as regards an Imperial air route and the establishment of local air lines along the route. Again, it should be noted that his total flying time for the flight works out at about 90 hours or 3¾ days, as against the 17 days taken in the case of the fastest sea routes.

However, in every respect this flight is without doubt a magnificent accomplishment, both as regards man and equipment. Cobham's prowess and efficiency in exploits of this character need no comment, whilst the behaviour of the D.H.50J. machine (the actual machine, by the way, but modified, on which he flew with Sir Sefton Brancker to Rangoon and back) and its Siddeley "Jaguar" engine (plus "K.L.G." plugs) have yet again demonstrated the high quality of British aircraft. Mr. Cobham has expressed nothing but praise for engine and machine throughout the whole trip, and has referred specially to the effectiveness of the "Titanine" dope, which has withstood the varying and trying conditions. He also gives praise for the all-important matter of fuel supplies, for not only did he find ample supplies of "B.P." spirit and Wakefield "Castrol R." all along the route, but both these necessities gave entire satisfaction.

Perhaps it may be as well if we give on this occasion a simple log of the flight from start to finish. This, including the distance completed at each stage, is as follows:—

1925.

Nov.	16.	Stag Lane, Croydon–Le Bourget	(240 miles).
,,	17.	Le Bourget–Marignane ..	(640 ,,).
,,	18.	Marignane–Pisa	(925 ,,).
,,	19.	Pisa–Taranto	(1,400 ,,).
,,	20.	Taranto–Athens	(1,765 ,,).
Dec.	6.	Athens–Sollum	(2,215 ,,).
,,	7.	Sollum–Cairo	(2,605 ,,).
,,	16.	Cairo–Luxor	(2,825 ,,).
,,	18.	Luxor–Assuan	(3,085 ,,).
,,	20.	Assuan–Wadi Halfa	(3,275 ,,).
,,	21.	Wadi Halfa–Atbara	(3,605 ,,).
,,	22.	Atbara–Khartoum	(3,755 ,,).
,,	28.	Khartoum–Malakal	(4,185 ,,).



Sketch Map of the London-Cape Town Flight.

1926.

Jan.	2.	Malakal–Mongalla	(4,545 miles).
,,	10.	Mongalla–Jinja	(4,890 ,,).
,,	13.	Jinja–Kisumu	(5,000 ,,).
,,	18.	Kisumu–Tabora	(5,400 ,,).
,,	19.	Tabora–Abercorn	(5,685 ,,).
,,	20.	Abercorn–N'Dola	(6,030 ,,).
,,	23.	N'Dola–Broken Hill	(6,140 ,,).
,,	29.	Broken Hill–Livingstone	(6,430 ,,).
,,	31.	Livingstone–Bulawayo	(6,670 ,,).
Feb.	2.	Bulawayo–Pretoria	(7,100 miles).
,,	4.	Pretoria–Johannesburg	(7,135 ,,).
,,	15.	Johannesburg–Kimberley	(7,415 ,,).
,,	16.	Kimberley–Bloemfontein	(7,495 ,,).
,,	17.	Bloemfontein–Cape Town	(8,115 ,,).

Throughout the flight Mr. Emmott has taken numerous photographs and films of various places and items of interest, and this film, when "shown," should not only provide exceptional interest, scientific as well as popular, but should also provide excellent material for British aviation propaganda.

SIR SAMUEL HOARE AT CAMBRIDGE

SPEAKING at a meeting of the Cambridge University Aeronautical Society on February 17, Sir Samuel Hoare said he was particularly glad to meet the members at a time when the University was showing an added interest in aviation in connection with the starting of the Cambridge University Air Squadron. He congratulated them upon the successful start that had been made, and would tell them that there were few recent developments in the field of British flying to which he looked with greater hope and confidence than the new movement started there and at Oxford. They had already set up the framework of their organisation, their squadron with its special appeal to those who wished to become Air Force officers, with its opportunities for the study of the technical side of aeronautics for those who were interested in technical questions, and with its stimulus to those who desired to push further the line of progress in the almost limitless field of scientific research. Good luck to the work of the Squadron in all these three directions.

He was there, proceeded Sir Samuel, not only to congratulate the club, but to say something about British flying, but he felt some hesitation in doing so before that audience, as he was no expert either upon the scientific or practical side of flying. He would therefore give them the general impressions of an ordinary person who had become connected with flying a short time ago, and who asked himself the question—what part is flying going to play in the life of the nation and of the Empire?

Most people have now grasped the fact that the invention of flying was revolutionising our system of defence. It was to be presumed that year by year, as the aeroplane and its armament became further developed and as the Air Forces of the Great Powers became stronger, this fact would become more and more apparent. Whilst he felt sure that the uses of air power would be extended in the field of home and Imperial defence on the ground of economy, if for no other reason, neither he nor the Air Staff held the foolish view that air force was the only force that mattered, and that navies and armies were obsolete.

The defence problem of the future was not the elimination of one or other of the three fighting Services, nor the merging of all these into a single service, but rather a more intelligent division of labour under which the best and most economical use would be made of each.

Regarding the part civil aviation would play in our lives in the near future, he found himself torn between the optimists, who believed that civil aviation could do everything, and the pessimists, who were certain it could do nothing. He thought civil flying was considerably further developed than was railway travelling 100 years ago, and motor travelling 25 years ago. In a space of six or seven years civil flying had established itself as a regular means of transport in every civilised country of the world. Year by year progress was being made with the solution of the problems of safety and regularity. At present there were two practical difficulties still to be surmounted: flying at night and flying in a fog. They had made substantial progress in both directions, and he advised any interested in the question to go to Croydon and see what was being done with the lighting of the aerodrome and with certain other improvements.

There was still, however, one outstanding problem, and it was no use underrating it—the difficulty of expense. Organised civil flying was nowhere self-supporting. Everywhere it needed Government subsidies. If civil flying was going to play a really great part in the life of the nation, its cost would have to be reduced to an economic self-supporting figure. It was because he believed that result would be eventually reached that he changed the system of yearly subsidies to the present system of a ten-year subsidy, during which civil flying would have a chance of establishing itself as an economic proposition.

Another difficulty, he said, was that of building up an air route that would possess such great advantages over the land or sea route as to ensure a sufficient quantity of passengers and freight—an obvious difficulty in a small country like England, where road and railway transport were developed to a unique degree. It could only be met by pushing out air routes over distances so long as to mean a great saving of time in transport. Hence the policy of long-distance flying routes within the Empire.

Sir Samuel then referred to the future Empire air routes, two he had in mind being London-Calcutta and London-Cape Town. Alluding to the airship experiment, which he asked them to follow closely and sympathetically, he said that they were engaged upon it with a full sense of the difficulties and with a keen memory of the disasters behind, and for a year and a-half they had been studying all the lessons of the past and all the available evidence that might be procured from full-scale experiments and scientific research. He hoped and believed that during the lifetime of the present Government the two great airships now being built would be flying safely between England and the distant cities of the Empire.

As regards the part flying would play in industry, Sir Samuel stated that if flying was to be a healthy growth, it must have its established place in the world of industry—there should be the closest possible connection between the Air Force, the Air Ministry and industry generally. At present the difficulty was that the aircraft industry was dependent almost entirely upon the orders of the Air Ministry, but until civil flying developed further he could not see how the position could be remedied. There was a general need for the linking up of our air system as closely as we could with the British industry. It was to be hoped that the experiment started this year with the formation of Auxiliary and Special Reserve Squadrons would create another connection between the Air Force and the industry.

Sir Samuel concluded his speech in reviewing the work, mainly on the science side of the Club in connection with aviation. He referred to the work done by Prof. Jones regarding the stability of aeroplanes, Prof. Taylor in wireless, meteorology and flying, and to those scientists who lost their lives in the cause of flying such as Prof. Hopkinson, Mr. Keith Lucas (Trinity) and Capt. Busk.

Among those present at the meeting were:—Sir Geoffrey Butler, K.B.E., Sir Arthur Shipley, General Costello, V.C., Colonel the Hon. I. M. Campbell, D.S.O., Wing-Cmdr. J. B. Bowen, O.B.E., Prof. C. E. Inglis, O.B.E., Prof. B. Melville Jones. Sir Arthur Shipley proposed a vote of thanks to Sir Samuel Hoare.

Sir Philip Sassoon at Brussels

SIR PHILIP SASSOON, Under-Secretary for Air, delivered a lecture before the Belgian Aero Club at Brussels on February 20, H.M. the King of the Belgians being present.

R.A.F. *v.* Army (Fencing)

THE fencing match, between the Army and the R.A.F., which was fought on February 17, produced some excellent play. Foil, épée, sabre and bayonet were the weapons, and the Army beat the R.A.F. in three out of four of these, viz.: Foil (5 to 4), épée (5 to 4), and bayonet (5 to 4). R.A.F. won sabre (5 to 4).

The Royal Air Force Memorial Fund

THE fortnightly meeting of the Grants Sub-Committee was held at Caxton Street, on February 18. Lieut.-Commander H. E. Perrin was in the Chair, and the other member of the Committee present was Mrs. L. M. K. Pratt-Barlow, O.B.E. The Committee considered in all 16 cases, and made grants to the amount of £37 7s. The next meeting was fixed for March 4, at 2.30 p.m.

LIGHT 'PLANE CLUB DOINGS

London Aeroplane Club

THE total flying during the week was 16 hours 25 mins. with one machine only available.

The following members had flying instruction: J. S. M. Michie, R. C. Brighten, R. C. Presland, R. L. Preston, R. P. Cooper, N. James, Sir John Rhodes, S. O. Bradshaw, E. S. Brough, C. E. Murrell, C. H. Gould, A. R. Ogston, W. E. P. Johnson, A. P. Hunt, L. C. J. Mitchell, T. H. O. Richardson, G. Quirk. B. B. Tucker, O. J. Tapper, R. Thomas.

The following Members flew solo: Mrs Eliott-Lynn, P. G. Lucas, Major Beaumont, G. N. Warwick.

Capt. F. G. M. Sparks has now returned from his Instructors' Course at Upavon, and has been passed as an A.I. Certificate.

The Lanchester Motor Co., Ltd., of Birmingham, has kindly presented to the Club a sectioned R.A.F. engine for instructional purposes.

The Lancashire Aero Club

FLYING took place on Tuesday morning, Wednesday afternoon and Saturday and Sunday. Mr. Cantrill and Mr. Scholes gave "dual" to the following: A. Macnair, 1 hr. 10 mins.; H. Jowett, 35 mins.; P. Michelson, 55 mins.; R. Colley, 40 mins.; C. Agar, 50 mins.; R. Williams, 20 mins.; D. Tummers, 45 mins.; H. Stern, 45 mins.; C. Parker, 20 mins.; L. Slater, 25 mins.; A. Goodyear, 15 mins.; J. Chadwick, 25 mins.; D. Dyson, 15 mins.; J. Leeming, 15 mins.

Solo flights by M. Lacayo, 35 mins.; R. Williams, 10 mins.; test occupied 35 mins., solo 45 mins., dual 8 hours 20 mins. Total 9 hrs. 40 mins.

The third Annual General Meeting will be held at the Club Headquarters in Manchester at 7.30 p.m. on March 2.

Newcastle-upon-Tyne Aero Club

Flying report for week ending Sunday, February 21, 1926.—All the weather forecasts have been fulfilled this week. On Monday only a half-hour was completed, Miss Leathart being the heroine, who carried out 30 mins. dual under Major Packman. No flying at all on Tuesday. There was rain almost continuously on Sunday, but five Members flew under instruction, with Major Packman, and three pilots flew solo, though whether for pleasure or a matter of duty is not known.

Total time for the week 20 hrs. 8 mins., made up as follows:—Dual, 16 hrs. 3 mins., solo, 3 hrs. 30 mins. (all "A" pilots); passenger, 30 mins.; test, 5 mins.

The following members flew under instruction, with Major Packman, Miss Leathart, Mrs. Marcks, Mr. MacMillan, Mr. W. Todd, Mr. H. Ellis, Mr. Wardill, Mr. Twine, Mr. L. Smith, Mr. C. Thompson, Mr. Somerville Mr. Bruce.

Solo, Mr. N. S. Todd with Mr. Naylor as passenger, Mr. Baxter Ellis with Miss C. Ellis as passenger, Mr. P. F. Heppell with Mrs. Heppell, Mr. R. N. Thompson with Mrs. Marcks on one flight, other passengers not known.

Major Packham flew with Mr. Alderson as passenger.

The repairs to *Bernicia* are now completed, and, weather permitting, Major Packman will fly it up from Stag Lane on February 26.

To those who patiently listened to the monotonous sound of rain on the roof of the hanger on Sunday, while the machine was flying, the following incident would no doubt prove a welcome break in some cases at any rate.

A member, about to take a passenger for a 15 mins. flight, twice became stuck in the mud when commencing to taxi. After being dislodged for the second time he opened out his engine a little and it was presumed that he intended to taxi up to the opposite end of the aerodrome and turn. He did not do this, however, and the spectators were horrified to see the tail of the machine rise and (much) later the machine took off. Mr. Brown immediately proceeded to light a fire on the aerodrome, and, on alighting, the pilot concerned thanked him profusely for so thoughtfully indicating the change of direction of the wind, and was about to mention that the engine did not appear to be pulling well when he took off. It was then pointed out that the wind had not changed during the flight.

The following Petrol Distributing Companies: Anglo-American Oil Co., Ltd., British Petroleum Co., Ltd., Redline Motor Spirit Co., Ltd., Shell-Mex Ltd., have together handed to the Royal Aero Club the sum of £1,000 which is to be applied for the purpose of encouraging Light Aeroplane Clubs under the Air Ministry scheme.

It is the intention that this sum shall be used in connection with the purchase of new aeroplanes, but it is a condition that before any Club obtains assistance from this fund it must first satisfy the Royal Aero Club that it has already been able to obtain from other sources a considerable portion of the necessary money. It is also stipulated that the type of aeroplane to be purchased is to be approved by the Air Ministry.

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BRITISH PRIVATE AIRCRAFT OWNERS' CLUB

THE inaugural meeting of the British Private Owners' Club took place at 3, Clifford Street, on Wednesday, February 17, by kind permission of the Royal Aero Club.

The objects of the formation of the club are:

1. To bring together as members of the club persons owning aircraft exclusively for private purposes; and to provide an organisation whereby private aircraft owners can meet together to exchange views and discuss aeronautical affairs. This is being done by having a club dinner every other month.

2. To eventually promote flying contests amongst private aircraft owners and offer prizes. It is hoped, if possible, to arrange a one-day air race meeting during 1926.

Membership is only open to ladies and gentlemen who own or have owned, as amateurs, their own private aircraft. All members at present serve on the Committee. The subscription is 10*s*. (ten shillings) per annum with no entrance fee. Mr. David Kittel, Artillery Mansions, Westminster, is acting as Hon. Secretary and Hon. Treasurer.

At the inaugural meeting the following Founder Members were elected:

Captain G. de Havilland, M.B.E. (D.H. Moth).
Captain H. Broad (Avro).
Captain F. T. Courtney (Boulton and Paul P. 9).
R. L. Preston, Esq., Coldstream Guards (B.E.2.E.).
Wing Commander Weir (D.H. 51).
Wing Commander Wynne, O.B.E. (D.H. Moth).
Flight Lieut. Hamilton, M.B.E., D.F.C. (Martinsyde).
Flight Lieut. Soden, R.A.F. (Austin Whippet).
Doctor Whitehead Reid (S.E. 5).
David Kittel, Esq. (D.H. Moth).
Dudley Watt, Esq. (Sopwith Grasshopper).
(Name in brackets indicate the machine of the private owner).

A meeting and dinner of the club will take place on Wednesday, April 7. Members will be notified of full particulars.

◈ ◈ ◈ ◈

AN ITALIAN "SEMI-LIGHT 'PLANE": The Montorfano "R.7" two-seater biplane, constructed by the famous Italian shipbuilding firm, Cantieri Navali di Monfalcone. It is fitted with a 60 h.p. Combi 6-cylinder water-cooled engine, and has the following characteristics:—Span, 28 ft.; O.A. length, 20 ft.; area, 258 sq. ft.; weight empty, 815·8 lbs.; weight laden, 1,323 lbs.; weight/h.p., 22 lbs.; weight/sq. ft., 5; speed range, 37-83·7 m.p.h.

The AIRCRAFT ENGINEER

FLIGHT ENGINEERING SECTION

Edited by C. M. POULSEN

February 25, 1926

CONTENTS

OUR CONTRIBUTORS

Mr. J. D. North will be too well known to our readers to require any introduction here. Perhaps he is best known for his work on all-metal, and more particularly all-steel, construction of aeroplanes, a form of construction in which the firm with which Mr. North is connected—Boulton and Paul, Ltd.—has specialised for several years. We regard ourselves as being extremely fortunate in having obtained from Mr. North the promise of a series of articles, the first of which appears in the present issue. For a start, Mr. North will deal, not with metal construction, but with the subject of performance, the reconsideration of which, in the light of the vortex theory and dimensional theory, is considered essential to the determination of optimum types of construction.

Mr. J. D. Haddon, who has, we understand, been associated with several firms during their earlier work on metal construction, contributes an article on the design of metal spars of the type built up from strip. The subject is one that is coming to the fore very much at the present time, and the example given should be of material assistance to those whose duty it will be during the next year or two to produce satisfactory spars of this type. Mr. Haddon also gives a few words of advice on the design of rollers, and illustrates his method by an example.

Mr. F. T. Courtney is one of Great Britain's best known test pilots, and has flown a very large variety of machines. He holds some very pronounced views on the subject of control and stalling (as on most other subjects), and, although the article which he has contributed is not a technical one, we have thought ourselves justified in publishing it in THE AIRCRAFT ENGINEER, since this will give technical experts an opportunity of replying. The article is of rather a controversial character, and doubtless will call forth a lively correspondence.

"**In the Drawing Office**" is a section which we propose to devote to time-saving "dodges," and the Editor will welcome contributions for this section. In this issue Col. Blyth gives a short cut to the calculation of areas and moments of inertia of streamline struts.

AIRCRAFT PERFORMANCE.

By J. D. North, F.R.Ae.S.

There is no property of the aeroplane flying machine which arouses greater interest in all associated with its design, manufacture, or use, than what we have come to call "performance." Performance, of course, is a very vague word. It is vague in the sense that the term manœuvrability is vague, and the properties of manœuvrability and performance merge into one another and overlap. If we consider manœuvrability to mean the capacity of an aeroplane to take up a fresh position in space, we are bound to take into consideration its properties of movement in two of the six degrees of freedom, viz.:—its horizontal and vertical speed. More strictly, we should confine the question of performance to the study of a two-dimensional motion of the aeroplane in its plane of symmetry. If we accept this definition of performance, we can cover the whole question of taking off from rest, climbing and flying at various heights and throttle settings, and we can specify properties within these limitations which will serve to define the requirements of aerodynamic design, except in so far as they may be limited by extraneous considerations, such, for example, as the necessity for rapid angular motion about any axis, or arbitrary limitations of size, or arrangements from considerations of housing, accommodation, or functional requirements such as view, gun power, etc.

In examining the question of performance, it is difficult to find a real starting point. We might assume that the starting point was the user's specification; in other words, that his specification will require the machine to carry a definite useful load, and to be capable of a certain performance (and we shall continue to use this word to mean linear motion in the plane of symmetry) for a given endurance. He will, in addition, require certain economic conditions to be satisfied. This, in fact, really begs the question, since the user's requirements, particularly in military matters, are based, not on some extraneous principles of economics, but on the inherent performance capacity of the aeroplane flying machine. It is, therefore, necessary for the user to know what can be obtained before he can accurately specify his requirements. This is more difficult since, even within the limits as to the meaning of performance laid down, there are an infinite variety of combinations of climb and speed at the disposal of the user. Thus, the grade or class of performance may be interpreted as a rapid and sustained climb to great heights, as if a machine were being designed for taking the altitude record, or, alternatively, it may be interpreted as speed at ground level, as if the machine were intended for

special racing purposes. Two aeroplanes to satisfy these conditions would be extremely different. In between these two extremes, there lies a very wide choice in which to combine these two conflicting properties.

When an aeroplane is used for commercial purposes, the choice of policy is perhaps not so difficult. Meteorological and navigational considerations will tend to fix the operational height, or at least the limitations of operational heights to a fairly accurate degree. The economic speed can be assessed with some degree of accuracy and the ground conditions are either known or may be decided upon. At present in civil flying, ground conditions place a quite arbitrary limitation on the design of commercial aeroplanes, and it does not by any means follow that aeroplanes which are designed to meet these conditions are necessarily the best from an economic standpoint.

In military aeronautics, the problem is far more difficult. The measure of requirements is the defensive power to meet a possible offensive and the offensive capacity to operate in the face of other defences. A premium must always be placed on a high grade of performance since the initiative of action will go to those with whom this advantage lies.

This relationship between true air speed and indicated air speed is the fundamental aerodynamic effect of height. It is true that unless some arrangements, such as supercharging, are made to compensate for the change of pressure and temperature with altitude, this change modifies the brake mean effective pressure of the engine, but this has an influence which may be considered, so far as its primary effects on performance are concerned, independently. I have no belief in any system of attack on the problem of performance which aims to set down the *desiderata* in terms of the variables and from that to determine the optima, because the number of variables at the disposal of the designer is so large that completely to take account of them is impossible, while to include so many of them as may render the solution of the differential equations practicable, is to take away the very things which represent the difference between good and bad design. It is true that by studying the primary influence of varying the shapes and proportions of an aeroplane, we may get an approximate position outside the scope of our experience, but in the end better results can, with the assistance of this initial guidance, be attained by the designer, who subconsciously assesses what he may best do with the variables

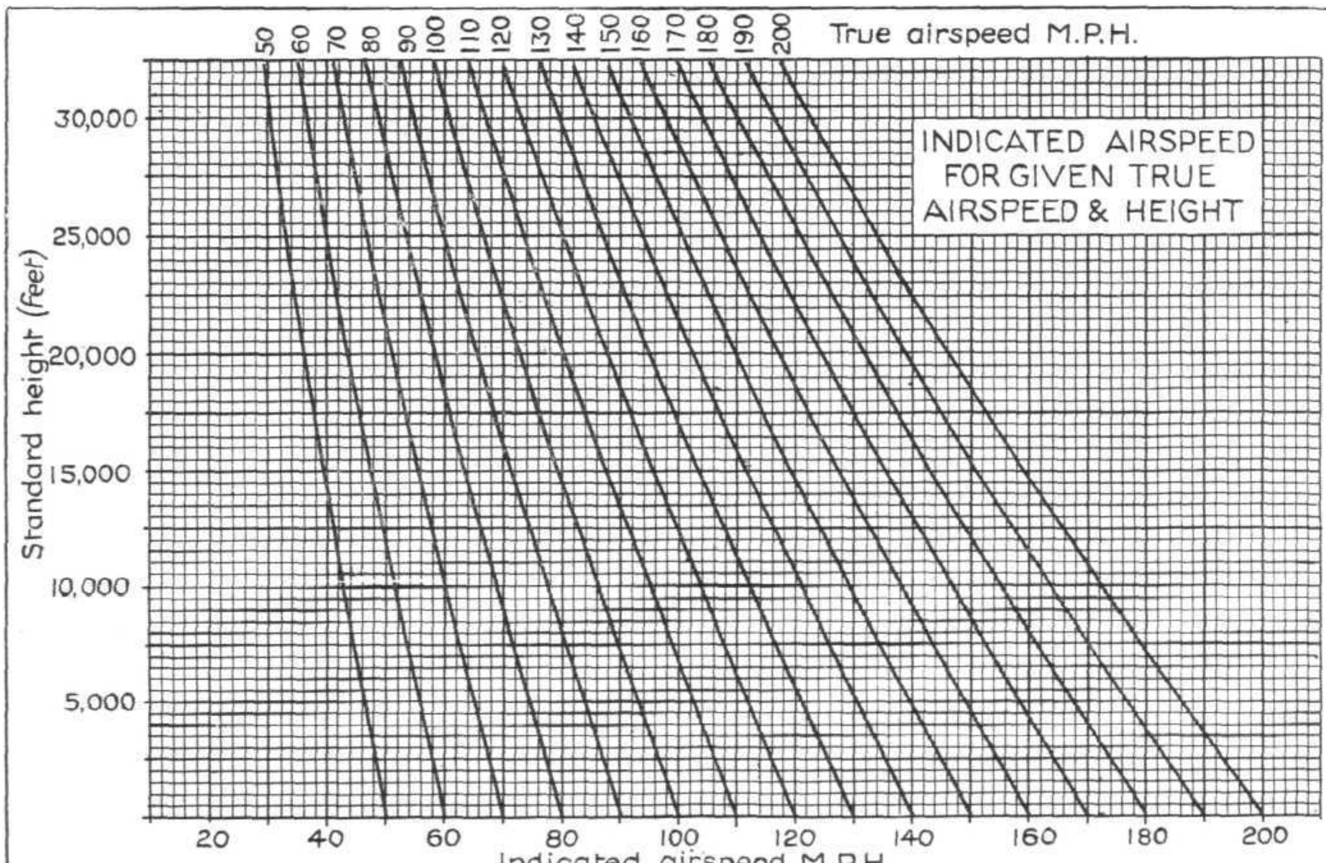


Fig. 1.

In offensive aircraft, it may be elected to use this high performance capacity for very high speeds low down, or for operating at great heights. In either case, the defensive aircraft must be designed for one or other of these conditions. It can hardly be expected to compete successfully in both. However high your defensive aeroplanes can fly, they are clearly useless if they cannot overtake offensive machines at their chosen level. However fast they can fly, they are clearly of no use if they cannot reach the level at which offensive machines are operating. This choice of operating height is the very essence of military aeroplane design, determining as it must do, the whole policy of the designer in his endeavour to satisfy tactical requirements. It will be profitable to examine in this issue, Fig. 1, which has been printed in fairly large size so that it may be cut out for future reference purposes, as it will constantly be necessary in thinking of different types of aeroplanes to refer to this figure, which shows the relationship between true air speed and indicated air speeds at various standard altitudes.

at his disposal. This, in fact, is design which is ultimately an art and not a science in aeronautics, as in all other engineering work. It is only possible, therefore, for us to present the case of varying one thing after another, considering, to start with, the primary and more important factors to get a broad view of the secondary factors, which may be studied as an important refinement later. From the aerodynamic side, we may call the primary factors of an aeroplane the lift and drag of the wings and the drag of the body and other detrimental resistance, and from the engine side, the thrust, the propeller efficiency and the power. The secondary effects include the influence of the slip stream, the resistance and drag of the stabilising organs, such as the tail and the fin, interference and variations of engine speed at full throttle. Of the primary factors, the lift and the drag are associated with the indicated air speed, while the propeller efficiency depends on the true air speed and the thrust on both true air speed and the height, although the conversions of thrust to power depends on true air speed only. In so far as the primary

aerodynamics of the wings are concerned, the use of the quantitative vortex theory has thrown into its true perspective the whole mass of partially and imperfectly correlated data on wing sections, plan forms and multi-plane combinations. It is hardly necessary to mention that this theory has not enabled any appreciable improvement to be made in wing sections. It does, however, effectively dispose of the many exaggerated claims which have been made, in most cases quite genuinely and disinterestedly, as to the advantages to be gained by particular classes of wing section, or systems for adjusting them, together with many other aeronautical panaceas. I do not desire, in what is purely an engineering article, to discuss the history of the vortex theory. It is sufficient to mention in passing the brilliant and neglected piece of inductive reasoning which is to be found in the early work of Mr. F. W. Lanchester, and the extensive work carried out by Continental mathematicians in placing Lanchester's hypothesis on a quantitative basis, which has been

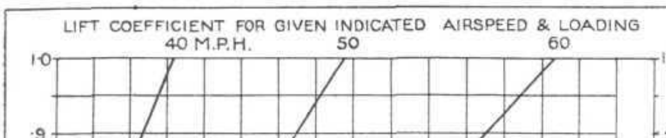


Fig. 2.

made available to English readers by H. Glauert in certain Reports and Memoranda of the Aeronautical Research Committee and by Max Munk in the publications of the National Advisory Committee for Aeronautics of the United States of America. The former of these two I shall use for purposes of reference, as they are most easily accessible to readers in this country, and contain fairly full reference to the original German work. I propose to consider the quantitative basis of this theory as established. The published experimental evidence is practically conclusive, and if that were not enough my personal experience, and I believe that of all others who have had the matter investigated afford, to me, ample additional confirmation. It is very necessary, in order to use the vortex theory to advantage, to think of wings in terms of those characteristics which the theory indicates to be criteria. So far from this presenting a difficulty, the whole conception and visualisation of wing sections and the mechanism of lift, is so much simplified that one is able to look at experimental results with the same appreciation of their true perspective as one receives from a stereoscopic picture. It is not important from the standpoint of the engineer whether the mechanism of lift on which this theory is based is real or not. If it satisfies our observations it should be enough for the engineer, who, of all people, ought to be content so far as his work is concerned with a metaphysic philosophy. As all the properties of wings are associated with lift, it is necessary to think of the conditions under which a wing operates in terms of its lift coefficient.

Fig. 2 connects the lift coefficient with indicated air speed for various loadings, the lift coefficient being in accordance with the non-dimensional definition. This figure, in conjunction with Fig. 1, will enable the reader instantly to see at what lift coefficient under any reasonable conditions of height and speed the wings of an aeroplane are working for loadings between 5 and 20 lbs. per square foot, and in thinking of, or examining the performance of any aeroplane, it is first of all necessary to find out and fix firmly in the mind the lift coefficient associated with the particular speed and height which is being considered. It thus follows, that so far as the wings are concerned, the specification of performance, in so far as it relates to steady motion in flight, can be associated with the definite values of the lift coefficient.

METAL SPARS.

By J. D. HADDON, B.Sc., A.F.R.Ae.S.

It has been my experience that several firms starting metal construction are spending unnecessary money by designing their first spar section on the trial and error system. Also the man in the drawing office is at a disadvantage, through lack of experience in this type of construction, in stressing, designing rolls, etc. A lot of this could be obviated if the designer had at his disposal certain information, which it is the object of this article to supply.

Fig. 1 shows three typical rolled steel spars.

Metal spars are so varied in design that it is impossible to discuss them all here. However, certain principles are common to all. We will therefore follow the design of one throughout.

Assume a spar is required for a bay 30 in. long (1), 5,000 lbs. end load (P), 120 lbs. per ft. run (w) and bending moments at ends 1,500 ft.-lbs. (Ma) and 1,400 ft.-lbs. (Mb).

The first step is to choose the form our spar is to take. In this connection the following points must be taken into account :—

Edges of metal must not be at points of high stress, *i.e.*, top or sides as Fig. 2 (*a* and *b*). (*b*) would be O.K. if the end had a small radius as Fig. 1 (*a*). Do not allow any flats as in Fig. 2 (*c*) X—X. Two large radii adjacent produce a flat where they meet; always at highly stressed parts put a small radius next to a large, as Fig. 1 (*a*) flange. This is not so necessary in the web where the stress is small.

Maximum radius must not exceed 30t. It is no good taking the figure for tubes. It is obvious that an inch diameter tube will stand a greater r/t ratio than a tubular section say 12 in. diameter made up of several ½-in. radii.

Minimum radius for DTD 16/50 steel is 3t and DTD 16/52 is 1t.

Neglect of any of the above will lead to local failure before the spar develops its stress.

Remember that fittings and ribs will have to be attached after the spar is made up.

I have seen spars designed with the one thought that they must stand up to the stress and then handed to the poor draughtsman to incorporate in a wing; with the result that most elaborate and heavy fittings have to be made and in one case rib posts had to be attached before the spar was made up. It generally pays to make the webs of a lighter gauge than the flanges.

Heat treated strip in long length coils supplied by Messrs. Kayser, Ellison & Co., Ltd., cannot at present be got in a greater width than 6½ ins. for 0·015 in. to 0·032 in. thick. and 4½ in. for 0·010 in. to 0·015 in. thick. For fittings and side plates the steel K.E. 169 is supplied in the annealed state up to 7 in. in width.

We will make our spar of the type shown in Fig. 1 (*a*). Let its dimensions be as shown in Fig. 3 (*a*) and (*b*). Dimensions in (*b*) being got by scaling a drawing ten times full size.

Our next procedure is to find the area and moment of inertia.

Area = length × thickness.

FIG. 1

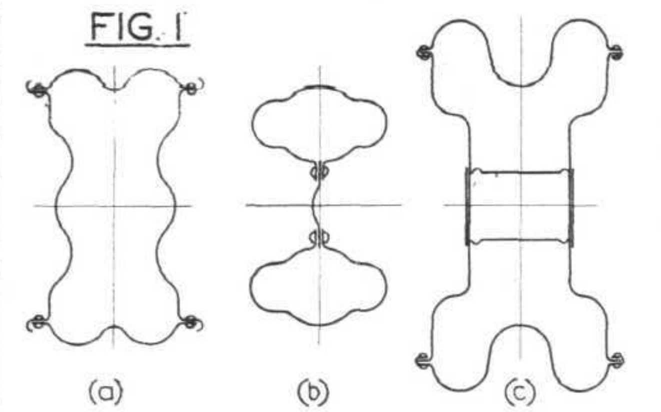
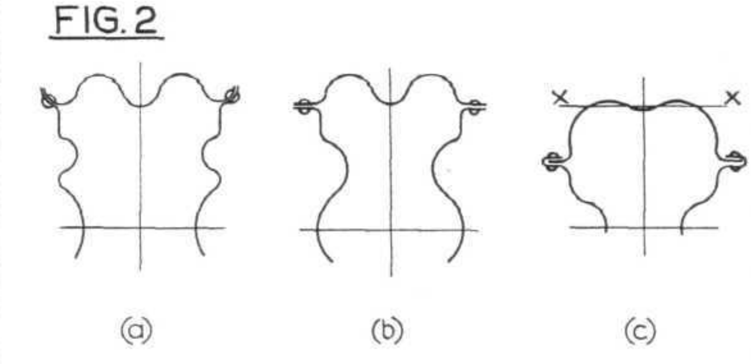


FIG. 2



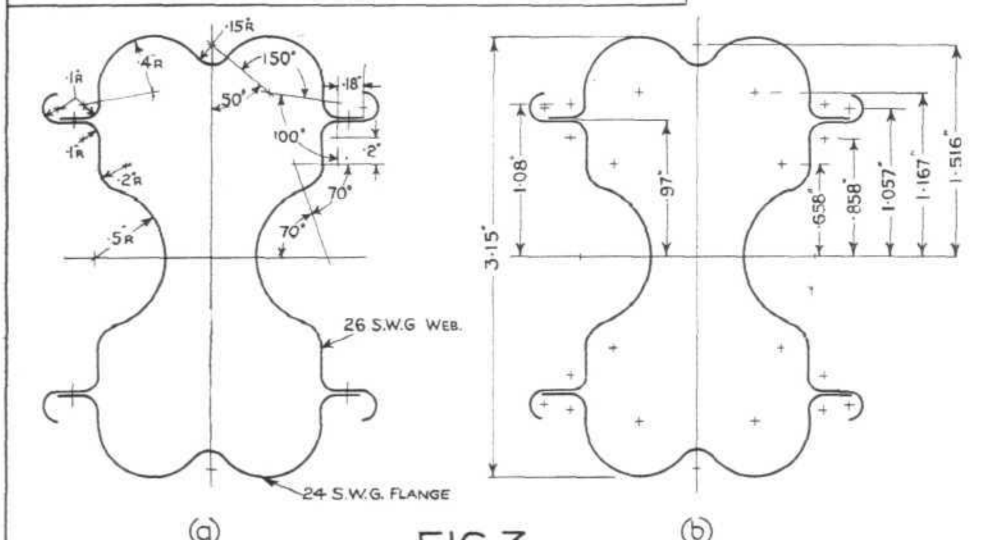


FIG. 3

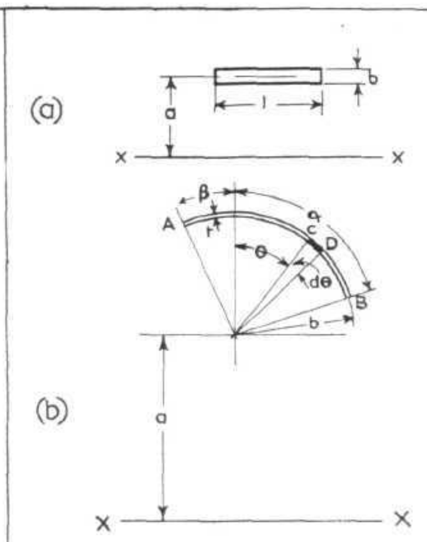


FIG. 4

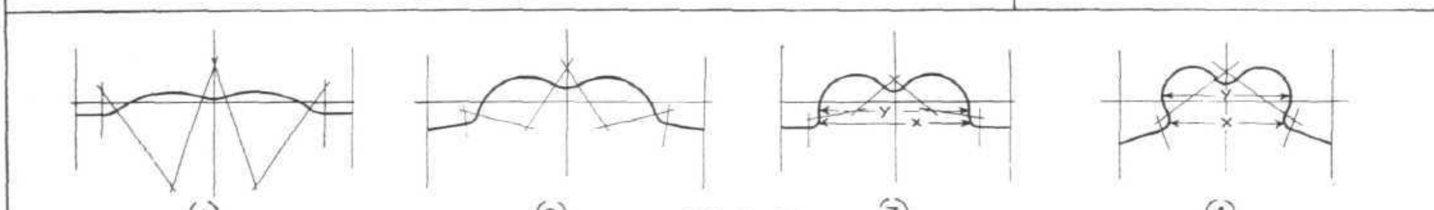


FIG. 5

Length of flange =

$$2\left(\frac{(50 \times 0 \cdot 15) + (150 \times 0 \cdot 4) + (100 \times 0 \cdot 1)}{57 \cdot 3} + 0 \cdot 18\right)$$

$= 3 \cdot 064$ in.

Area of flanges $= 3 \cdot 064 \times 0 \cdot 022 \times 2 = 0 \cdot 1348$ sq. in.

Length of Web =

$$2\left(\frac{(270 \times 0 \cdot 1) + (70 \times 0 \cdot 2) + (70 \times 0 \cdot 5)}{57 \cdot 3} + 0 \cdot 38\right)$$

$= 3 \cdot 41$ ins.

Area of Webs $= 3 \cdot 41 \times 0 \cdot 018 \times 2 = 0 \cdot 123$ sq. in.

Total area $= 0 \cdot 1348 + 0 \cdot 123 = 0 \cdot 2578$ sq. in.

The Moment of Inertia is best found by use of calculus. If we take any rectangle (Fig. 4 (*a*)) of length l, breadth b, and distance d from a line xx

$$\mathrm{I}xx = lb\left(d^2 + \frac{b^2}{24}\right)$$

if $\frac{b}{d}$ is very small it will be sufficiently accurate to say $\mathrm{I}xx = lbd^2$.

Now take the arc AB (Fig. 4 (*b*)) of radius b and thickness t, t being very small in relation to the distance from xx. The inertia is required about xx. CD is an infinitesimally small portion of the arc and its distance from xx will be $a + b\cos\theta$ and its inertia about xx, $t\,(a + b\cos\theta)^2\, bd\,\theta$, *i.e.*, distance squared × length × thickness.

The inertia of the whole arc AB will therefore be :

$$t \int_{-\beta}^{\alpha} (a + b\cos\theta)^2\, bd\,\theta$$

$$= tb \int_{-\beta}^{\alpha} (a^2 + 2ab\cos\theta + b^2\cos^2\theta)\, d\theta$$

$$= tb \int_{-\beta}^{\alpha} \left(a^2 + \frac{b^2}{2} + 2ab\cos\theta + \frac{b^2}{2}\cos 2\theta\right) d\theta.$$

$$= tb \left[\left(a^2 + \frac{b^2}{2}\right)\theta + 2ab\sin\theta + \frac{b^2}{4}\sin 2\theta\right]_{-\beta}^{\alpha}$$

Using this method for our spar we have :—

$$\frac{\mathrm{I\ flange}}{4t} = \int_{0}^{50} (1 \cdot 518 - 0 \cdot 15\cos\theta)^2\, 0 \cdot 15\, d\theta$$

$$+ \int_{-100}^{50} (1 \cdot 167 + 0 \cdot 4\cos\theta)^2\, 0 \cdot 4\, d\theta$$

$$+ \int_{0}^{100} (1 \cdot 08 - 0 \cdot 1\cos\theta)^2\, 0 \cdot 1 d\theta + 0 \cdot 18 \times 0 \cdot 981^2$$

$$= 0 \cdot 15\left[\left(1 \cdot 518^2 + \frac{0 \cdot 15^2}{2}\right)\frac{50}{57 \cdot 3} - 2 \times 1 \cdot 518 \times 0 \cdot 15\right.$$

$$\left. \times 0 \cdot 766 + \frac{0 \cdot 15^2}{4} \times 0 \cdot 985\right]$$

$$+ 0\cdot4\left[\left(1\cdot167^2 + \frac{0\cdot4^2}{2}\right)\frac{150}{57\cdot3} + 2 \times 1\cdot167 \times 0\cdot4 \times (0\cdot766 + 0\cdot985) + \frac{0\cdot4^2}{4}(0\cdot985 - 0\cdot342)\right]$$

$$+ 0\cdot1\left[\left(1\cdot08^2 + \frac{0\cdot1^2}{2}\right)\frac{100}{57\cdot3} - 2 \times 1\cdot08 \times 0\cdot1 \times 0\cdot985 - \frac{0\cdot1^2}{4} \times 0\cdot342\right] + 0.18 \times 0\cdot981^2$$

$$= 0\cdot251 + 2\cdot1755 + 0\cdot1837 + 0\cdot1735$$

$$= 2\cdot7827$$

$$\text{I flange} = 2\cdot7827 \times 4 \times 0\cdot22 = \underline{0\cdot245 \text{ in.}^4}$$

$$\frac{\text{I web}}{4t} = 0\cdot1 \times 1\cdot057^2 \times \pi + 0\cdot961^2 \times 0\cdot18 + \int_0^{90}(0\cdot858 + 0\cdot1\cos\theta)^2\, 0\cdot1\, d\theta$$

$$+ \int_{0\cdot658}^{0\cdot858} x^2\,dx + \int_{20}^{90}(0\cdot658 - 0\cdot2\cos\theta)^2\, 0\cdot2 d\theta + \int_0^{70}(0\cdot5\cos\theta)^2\, 0\cdot5\, d\theta$$

$$= 0\cdot35 + 0\cdot166 + 0\cdot1\left[\left(0\cdot858^2 + \frac{0\cdot1^2}{2}\right)\frac{90}{57\cdot3} + 2 \times 0\cdot858 \times 0\cdot1 \times 1\right] + \left[\frac{0\cdot858^3}{3} - \frac{0\cdot658^3}{3}\right]$$

$$+ 0\cdot2\left[\left(0\cdot658^2 + \frac{0\cdot2}{2}\right)\frac{70}{57\cdot3} - 2 \times 0\cdot658 \times 0\cdot2\,(1 - 0\cdot342) - \frac{0\cdot2^2}{4} \times 0\cdot642\right]$$

$$+ 0\cdot5\left[\frac{0\cdot5^2 \times 70}{2 \times 57\cdot3} + \frac{0\cdot5^2}{4} \times 0\cdot643\right]$$

$$= 0\cdot35 + 0\cdot166 + \cdot134 + 0\cdot116 + 0\cdot075 + 0\cdot097$$

$$= 0\cdot938$$

$$\text{I web} = 0\cdot938 \times 4 \times 0\cdot018 = \underline{0\cdot068 \text{ in.}^4}$$

$$\text{Total I of spar} = 0\cdot245 + 0\cdot068 = \underline{0\cdot313 \text{ in.}^4}$$

By Webb and Thorne's formula for Max. Bending moment we have :—

$$\text{Euler Load Q} = \frac{\pi^2 \text{EI}}{l^2} = \frac{\pi^2 \times 30 \times 10^6 \times 0\cdot313}{30 \times 30} = \underline{102800}$$

$$\text{M (max)} = \frac{\text{Q}}{\text{Q} - \text{P}}\left\{\frac{1}{2}(\text{M}_\text{A} + \text{M}_\text{B})\left[1 + 0\cdot26\frac{\text{P}}{\text{Q}}\right] + 1\cdot02\frac{wl^2}{8}\right\} + \frac{1}{2}\frac{(\text{M}_\text{A} - \text{M}_\text{B})^2}{wl^2}$$

$$= \frac{102800}{97800}\left\{0\cdot5\,(1900)\left(1 + 0\cdot26 \times \frac{5000}{102800}\right) + 1\cdot02 \times \frac{120 \times 2\cdot5^2}{8}\right\} + \frac{0\cdot5 \times (1100)^2}{120 \times 2\cdot5^2}$$

$$= \underline{1{,}918} \text{ ft. lbs.}$$

$$f\,(\text{max.}) = \frac{12\text{ My}}{\text{I}} + \frac{\text{P}}{\text{A}} = \frac{12 \times 1{,}918 \times 1\cdot575}{0\cdot313} + \frac{5{,}000}{0\cdot2578}$$

$$= 115700 + 19400$$

$$= 135100 \text{ lbs./sq. inch.}$$

Therefore, this spar will be O.K. in DTD 16/50 steel. We will now get out the rolls or dies for making the sections out of flat sheet. These must be made very accurately, for if the strip is gripped tighter in one place than another it will come out twisted.

The first rolls are got out by sight from experience ; the last but one is generally made of similar dimensions to the finished section and the last has to be such that the spring back will give the correct section, and is arrived at in the following manner:

We know that $\frac{\text{E}}{\text{R}} = \frac{f}{y}$.

If we denote the finished section constants by $\text{E}_1\,\text{R}_1 f_1$ and y_1 and those of the section in the last die by $\text{E}_2\,\text{R}_2 f_2$ and y_2 we get $\frac{\text{E}_2}{\text{R}_2} - \frac{\text{E}_1}{\text{R}_1} = \frac{f_2}{y_2} - \frac{f_1}{y_1}$, but $f_1 = 0$, as there is no stress in the metal after spring back and f_2 = yield stress, as the material yields in the die to give it its new curvature. This is not the yield stress from specification, but from test of material used, and is about 70 tons/sq. inch in DTD 16/50.

$$\text{E}_1 = \text{E}_2 \text{ and } y_1 = y_2.$$

We can therefore write $\text{E}\left(\frac{1}{\text{R}_2} - \frac{1}{\text{R}_1}\right) = \frac{f_2}{y}$

and $\frac{1}{\text{R}_2} - \frac{1}{\text{R}_1} = \frac{f_2}{\text{E}y}$.

We will work out the last die for the flange. Let us denote the arc of $\cdot15''$ radius by 'a,' $\cdot4$ by 'b,' and $\cdot1$ by 'c'

$$\text{then } \frac{1}{\text{R}a} = \frac{70}{13{,}600 \times 0\cdot011} + \frac{1}{0\cdot15} = \frac{1}{2\cdot137} + \frac{1}{0\cdot15} = \frac{1}{0\cdot1395}$$

$$\frac{1}{\text{R}b} = \frac{1}{2\cdot137} + \frac{1}{0\cdot4} = \frac{1}{0\cdot3365}$$

$$\frac{1}{\text{R}c} = \frac{1}{2\cdot137} + \frac{1}{0\cdot1} = \frac{1}{0\cdot0957}.$$

This gives our radii for the last die as $\cdot1395''$, $\cdot3365''$ and $\cdot0957''$ respectively. Now the length of arc of each separate curve must remain the same for all the rolls and dies.

Therefore the new angles will be

$$(a)\quad \frac{0\cdot15 \times 50}{0\cdot1395} = 53\cdot7^\circ.$$

$$(b)\quad \frac{0\cdot4 \times 150}{0\cdot3365} = 178\cdot7^\circ.$$

$$(c)\quad \frac{0\cdot1 \times 100}{0\cdot0957} = 104\cdot3^\circ.$$

Fig. 5 shows the rolls and dies. The first two may be rolls but the last two must be dies ; the distance x being less than y the rolls could not run in each other. No. 3 could be made suitable for rolls by cutting away the small portion that fouls. This being so small would not harm the strip.

The axes of the male and female rolls should be equidistant from the centre of the strip $x - x$; this minimises the amount of slip caused by the difference in linear velocity of the rolls, which increased with their difference of diameter at any point.

The rolls for the webs may be found in the same way ; it will be better to have five instead of four for this section.

Some firms have fitted a furnace to their drawbench and they draw the metal hot.

I have no experience of results, but would imagine that the dies would be difficult to design, the yield point being an *unknown quantity*. Against this method is the very much greater time taken. With good tools and a little experience, good results should be got from drawing cold. Twist is often due to badly made dies or drawing through two at once that are not in line.

It is better to have the rolls sliding on a splined shaft ; if they are fixed it is very difficult to get three or four dead in line. Always have a lead in on the dies. Make, say, ¼ in. of the die the true section and chamfer the rest off.

A test should be made of all new spars to see that they develop the required stress without local buckle.

The Editor will be pleased to receive for consideration articles dealing with constructional and designing problems. All articles accepted will be paid for at our usual rates.

AN INTERESTING UNDERCARRIAGE "LEG."

New Features of Beardmore Chassis.

Descriptive articles are, generally speaking, outside the scope of THE AIRCRAFT ENGINEER, unless they happen to be of a more technical character than is normally the case with articles of this kind, when an exception may be made at the discretion of the Editor. Such an exception is found in the following article on the new undercarriage "leg" designed and patented by Wm. Beardmore & Co. and Mr. W. S. Shackleton, their chief aircraft designer. Although a proprietary article, this "leg" should be of interest to all aircraft designers, as it incorporates certain new and interesting features, and since, if desired, arrangements could presumably be made with the patentees for fitting it on machines of other makes. The description which follows has been prepared by the Beardmore firm, to whom also we are indebted for the illustrations accompanying the article.—ED.

A general idea of the mounting of this device as applied to the Beardmore W.B. XXVI 2-seater fighter aeroplane is given in Fig. 1, and a diagram of the internal mechanism is shown in Fig. 2.

The leg consists essentially of two telescopic elements, provided with universal joints at the ends for fixing between a pivoted form of axle and some suitable point on the fuselage or wing, it being immaterial which end is considered as the moving one. The end fittings are of a special knuckle type in preference to ball ends, which latter are liable to be broken or strained unless care is exercised in dismantling and assembly.

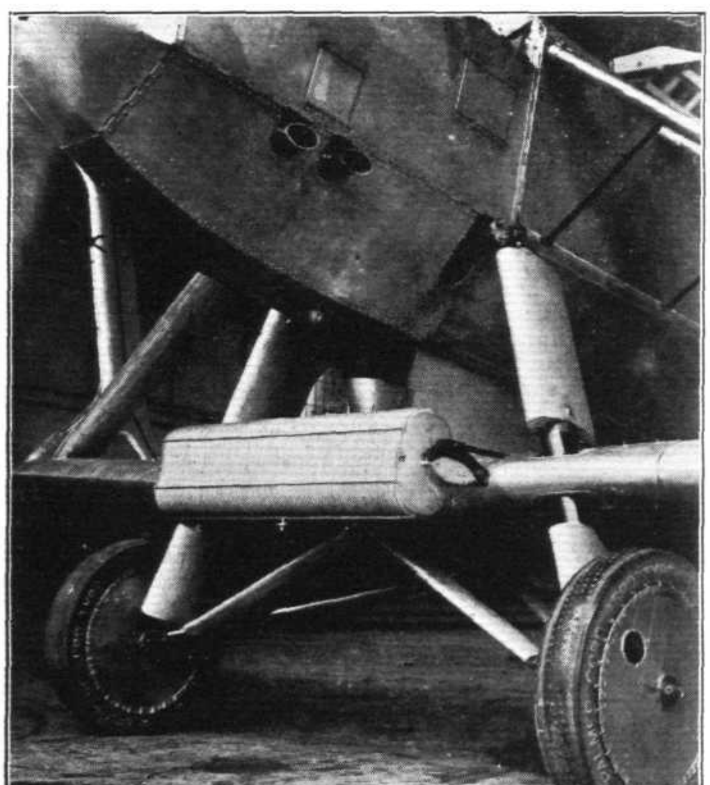


Fig. 1. Undercarriage of the Beardmore W.B. XXVI two-seater fighter, illustrating the general arrangement of the "Legs" shown in section in Fig. 2.

In Fig. 2, tube A is arranged to slide freely over tube B. On compressing the leg, the loads are taken directly through tube C, wedge D, slippers E, connecting rods F, and piston G to one or more helical coil springs H. Ferodo-faced friction shoes I are forced against the internal walls of tube B by the wedge D, and as the leg is compressed exert a braking or damping action. The radial force applied on each shoe is at all times proportionate to the force exerted by the springs and to the angle of the wedge. The braking force, or drag,

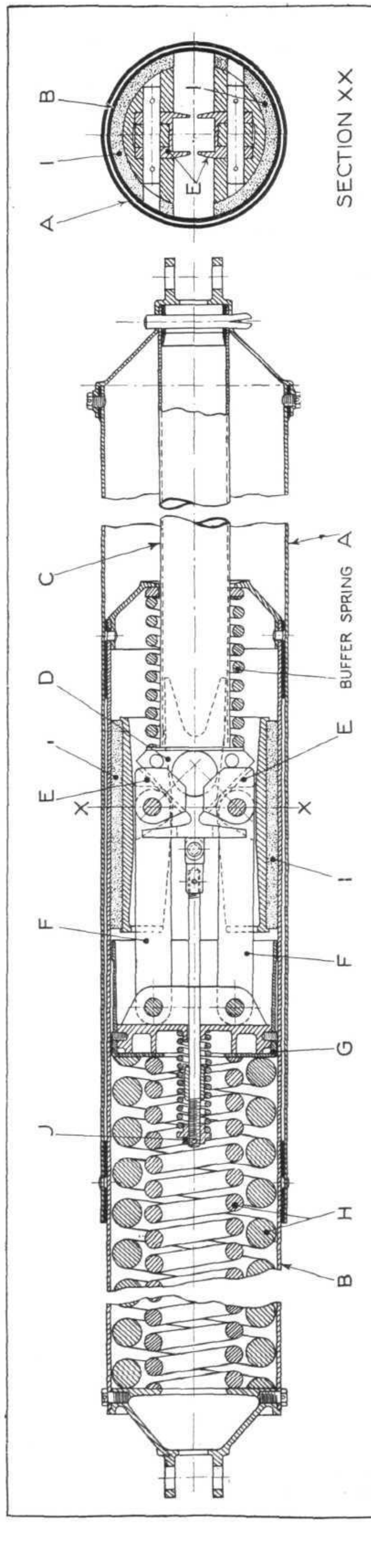


Fig. 2. Sectional drawings of the Beardmore-Shackleton undercarriage "Leg," in which Ferodo friction blocks are used for damping. In the drawing A is the outer and B the inner telescopic tube. The loads are taken directly through tube C, wedge D, slippers E, connecting Rods F, and piston G to the concentric coil springs H. The Ferodo-faced fric'ion shoes I are forced against the walls of tube B by the wedge D.

is proportionate to the total pressure on both shoes, multiplied by the coefficient of friction of the surfaces in contact, and is practically independent of the actual surface in contact. It follows, therefore, that the braking force is at all times a direct function of the load exerted by the springs.

The deflection of a helical coil compression spring is directly proportionate to the torsional modulus of elasticity, and to the applied load, and can be calculated with a close degree of accuracy. The deflection plotted against the applied load can therefore be represented by a straight line. A very useful and convenient feature of the helical coil compression spring is that the closing of the coils tightly against each other can be arranged to prevent over-stress in the spring. The pitch of the coils in the Beardmore landing gear has been so arranged that the maximum allowable stress is developed when the spring is solidly compressed. Two alleged defects inherent in springs of any type for aeroplane under-carriage work are: (1) that, whilst they absorb energy, they actually dissipate energy to only a relatively small extent, due to the low hysteresis factor, and (2) that the weight is excessive.

The first point does not arise in the Beardmore undercarriage, as any required proportion of energy can be dissipated through the Ferodo brakes. The weight is not excessive, provided the springs are designed to work at the high maximum stresses which can safely be obtained with modern steels. The chrome-vanadium steel springs used on the Beardmore undercarriage permit of a safe torsional shear stress in excess of 60 tons per square inch, which is about twice the usual allowed on springs of ordinary carbon steel. The use of alloy steel for springs does not alter the deflection of a spring under a given load to any appreciable extent. It merely allows a greater ratio of solid to free length. Therefore, in the case of two springs of identical dimensions, but made from high and low tensile steels respectively, a given deflection would require the same static load in both cases. The pitch of the coils, however, on the alloy steel spring would, in practice, be made greater so as to develop the higher stress when fully closed, resulting in greater range of movement, greater carrying capacity, and lower weight.

The weight of the complete undercarriage for the machine illustrated in Fig. 1, inclusive of wheels, tyres, fairings, etc., is only a little over 4 per cent. of the total all-up flying weight. This compares favourably with any other type of landing gear having a similar range of travel.

Further weight could be saved if hollow springs were a commercial proposition, but the difficulties involved in their production appear to be very great. Square section springs are not so suitable for this class of work, and are likely to work out heavier in practice than springs made from solid round stock. As a coil spring is stressed in torsion, the load-carrying capacity varies in a similar manner to the polar section modulus, and for torsion a square section is not so economical as a round one. Further, the stress distribution is higher in the corners of the square, which is liable to produce cracks and subsequent fracture.

A practical point worth knowing when two or more concentric springs are working together is to arrange the winding of adjacent springs in opposite directions so as to prevent interlocking.

Spring steels are now available with yield points in excess of 100 tons per sq. in. A representative composition and physical properties of a steel specially developed for use on the Beardmore landing gear by the Clyde Alloy Steel Co. is given herewith :—

Analysis.

	Per cent.
Carbon	0·42
Silicon	0·22
Manganese	0·82
Chromium	1·13
Vanadium	0·12
Sulphur	0·028
Phosphorus	0·026

Physical Tests.

Yield	102·1 tons.
Ultimate stress	112·4 ,,
Elongation on 2 in.	12·0 per cent.
Reduction of area...	43·4 ,,

The torsional modulus of elasticity can be taken as 12,500,000. Actual tests have shown that the coefficient of friction of Ferodo against steel, with the surfaces slightly lubricated, is of the order of 0·24 to 0·28. It has been proved that, with a mean rubbing pressure of 60 lbs. per sq. in. on the projected area of the shoes, practically unlimited life can be expected of the brake mechanism. In this connection it is well known that Ferodo material will stand up successfully for years in automobile brakes, where the conditions are very much more severe.

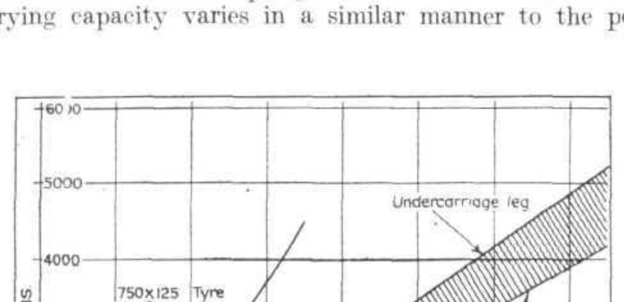
Automobile brakes are designed to absorb the kinetic energy resulting from the forward velocity of the vehicle, and as the kinetic energy varies as the square of the speed, this can have a very considerable value. For example, in the case of an automobile of 2 tons weight travelling at 60 m.p.h., the kinetic energy is equal to 540,000 ft./lbs.

In the particular application under review it is only the energy resulting from vertical velocities which has to be considered. On the Continent a vertical velocity of 3 m. per sec., and in this country 10 ft. per sec., are usually taken as the maximum values which need be considered. The length of stroke and shock absorption qualities are then so arranged that a definite load factor value is not exceeded.

Taking an aeroplane of 2 tons weight with 10 ft. per sec. vertical velocity, the kinetic energy is only 6,970 ft./lbs. and as a large proportion of this energy is absorbed in the tyre, springs and other parts, it is obvious that the Ferodo in this particular application is called upon to do relatively little, and that almost unlimited service can be expected of the brake elements. Energy is dissipated on both strokes. On completion of the landing stroke the energy stored in the springs is released as the leg extends to normal length. It follows that the forces exerted by the springs on the return stroke produce drag forces of corresponding amount in the brake elements, resulting in further dissipation of energy. The correct damping of the return stroke is important if bouncing is to be avoided.

With the present mechanism, any required ratio of spring force to brake force can be obtained by varying the angle of the wedge D.

A further constant brake resistance can be superimposed by suitable adjustment of the nut J. Practice has shown that the machine can be taxied or landed on extremely rough ground without there being any tendency to bounce. The springs are fitted without any initial compression. This facilitates assembly and at the same time ensures a considerable deflection under unit load. The legs are, therefore, not extended to full length until the machine



ig. 3. Representative Load/Deflection Curve of Beardmore ndercarriage. It should be pointed out that a deflection of ½ inches on the undercarriage "Leg" corresponds to a movement of 11 inches on the wheel.

leaves the ground, which arrangement gives increased travel and provides for considerable energy absorption before the undercarriage again reaches unit load.

Many tests were made to find the range of movement in service, and strangely enough the greatest deflections have been recorded in high-speed taxying over rough ground. Landings, made purposely severe, on the same ground have not produced so great a deflection.

Fig. 3 shows a representative load/deflection curve for an undercarriage suitable for a machine having a total all-up weight of about 3,200 lbs. The total work of compression for the two legs is equal to 3,250 ft./lbs., which figure is ample when allowance is made for the energy absorption of the tyres and the strain energy present in the axles and struts under load.

STALLED FLIGHT AND CONTROL.

The Practical Aspect.

By FRANK T. COURTNEY.

The fundamental factor in the question of the safety or otherwise of an aeroplane is the stall. The vast majority of aeroplane accidents, including landing accidents, can be directly attributed, in some way or another, to stalling. It follows, therefore, that the study of stalling is not merely the study of one of the very many interesting problems of aviation; it goes right to the root of aviation. Consequently, it is a matter on which the most accurate conclusions should be drawn. In my humble opinion the great amount of talking, writing and experiment that has been done recently on this subject has been done from a hopelessly unpractical standpoint, is very largely inaccurate, and is directly harmful as well as wasteful.

I have for a very long time closely studied this question, and I give here, for what they may be worth, my practical conclusions on the matter.

In the first place, what is the stall ? The lift on a cambered aerofoil is due to a phenomenon of air flow around the cambered surface, which has little or no resemblance to the lift that would be given by the vertical component of the air pressure on an inclined flat plate. When the cambered surface exceeds a certain angle of incidence (which, in actual practice, corresponds generally to a certain minimum or "stalling" speed), this flow quite suddenly breaks down.

It is true, in theory, *that this does not mean the complete loss of lift, since that form of lift is replaced by a much lower degree of lift, corresponding to the flat-plate lift. But*, in practice, *and in any normal reasonable aeroplane, this loss of lift is so great and so sudden as to amount to the complete loss of all lift on the wings. Moreover, even if the remaining lift is taken into account, it is accompanied by so high a drag that the corresponding gliding angle is steep enough to correspond with the dive of a liftless aeroplane.*

The forces then are too low to provide any useful parachute effect, so that I adhere to my contention that, for all practical purposes, the stalling of an aeroplane corresponds to complete loss of lift.

This is where, in my view, recent research in the matter has parted company with practical politics, since it has concerned itself with the pointless problem of "What shall we do when we have stalled ?" It has spent much time and money on the useless study of stalled flight, and incidentally evolved a useless mechanism to deal with it, which is based on arguments as plausible as they are inaccurate.

Before dealing with the arguments of the Aeronautical Research Committee, I should point out that the theoretical and aerodynamical facts concerned with stalling are reasonably simple and accurately known. The rest, therefore, is purely a flying problem, so that the flyer who has closely examined the facts as they occur is not in too weak a position to dispute with the scientists.

The arguments on which the Aeronautical Research Committee have based their conclusions are approximately as follows:—

(1) It is admitted that the vast majority of aeroplane accidents are due to stalling near the ground, and this occurs when a pilot in difficulties near the ground, accidentally stalls his machine in trying to extricate himself from the difficulty.

(2) Such stalling being almost invariably accompanied by the dropping of one wing or the other preparatory to spinning, the use of the ordinary aileron for raising this wing is applied. This, after stalling, has very little effect for raising the wing, but assists the spinning tendency owing to aileron drag.

(3) If an aileron were to be designed so as to maintain powerful lateral control, the pilot, though stalled, would be able to raise that wing, thus avoiding a spin, so that—

(4) The machine would then drop horizontally into the ground with less serious harm to its occupants than if it had spun (which at a low height generally means dived) into the ground.

At first sight these arguments seem very reasonable. A closer study shows, however, that they not only have little or nothing to do with the real circumstances involved, but are even technically inaccurate.

Let us take argument No. 1. The whole fallacy of this rests in the idea that the pilot *accidentally* stalls. He doesn't. The vast majority of stalling accidents are due to the *deliberate* attempt of the pilot to hold the machine in the air—to reach a field, to clear a tree, or what not—for a greater distance or period than is physically possible for the machine. He does not, of course, deliberately stall, but he does deliberately carry out those actions leading to the stall, and the mental attitude which makes him try and hold the machine up in defiance of his air-speed is really a subconscious defiance of the stall. Thus the arguments of the Aeronautical Research Committee have already broken down, since the problem has already almost ceased to be a mechanical one and has become a psychological one. The state of mind of the pilot immediately preceding such a crash is one of a greater or less degree of mental panic. Hence I might say in passing that I am convinced that those anti-stalling devices which give the pilot a warning forward kick on the control would in practice probably be worse than useless. For if a pilot's stick were kicked forward at the moment when his governing idea is to keep out of the ground he would pull it back still harder.

Argument No. 2 similarly leaves out most of the practical factors. In the first place, after stalling the impression given to the pilot by the dropping wing is really that of the nose diving away in a sideways direction. His governing idea, then, is to get the nose up, with such aileron control as he may manage to use when the stick is hard back. I have watched many such crashes, and have only once noticed any large amount of aileron movement. I consider that there is no question that a pilot who has let himself get into those circumstances has no other idea than "stick back." The ailerons, then, whether he uses them or not, have little to do with the main fact that the wings have lost their effective lift, the nose drops, and whether the wing drops or does not drop has no importance for the ailerons. For if the pilot had sufficient reason left to use his ailerons he would also use corresponding rudder, which, under the circumstances, would be a far more effective control.

If a pilot under those crash conditions cannot raise his wing, he dives into the ground somewhat sideways. If he does raise his wing he still dives into the ground forwards.

For, as regards argument No. 4, there can be nothing whatever to show that, even if under complete control, a stalled glide will differ much from a dive. Moreover, it has the additional disadvantage that, whilst a dive is something on the way to normal flight, a stalled glide under control would tend to remain a stalled glide, for, in any attempt to regain normal flight, the pilot would have to put himself through the dive stage. Nor would the machine maintain anything like a horizontal attitude fore-and-aft, unless an elevator control of preposterous dimensions were employed, or all normal stability systems upset.

The Aeronautical Research Committee have, however, put their money on the Slot-cum-Aileron lateral control as a useful means of preventing the worst effects of the stalled crash.

I have tried this gadget, and my impression is that, firstly, it does not do what is claimed for it, and, secondly, as my remarks above are intended to show, it would be of no use if it did.

It is true that, beyond the stall, this control provides a powerful rolling effect, so powerful as to throw the machine over the other way if hastily used. It also has a very powerful positive yawing effect, which, I understand, was one of the things it was particularly designed to avoid. On the machine to which this gadget is fitted for test—a standard Avro—it is true that during the use of the aileron the nose tends to come up, but this is Avro, and has nothing to do with control.

So far as this control may claim to raise the nose of the machine, it is true that the use of the slot on one side provides an addition to the total lift. This, however, has nothing to do with the control aspect of the matter. The whole stall could be avoided by the use of a complete slotted wing system, which, however, is apparently not proposed.

The mechanism is obviously heavy and expensive, and would undoubtedly be difficult to maintain in truth. It would not apply, probably, more than once in fifty thousand flights, and when it did it would be at the best of very doubtful value. Hence it seems difficult to understand that the control should have been recommended seriously to aircraft constructors as a means of achieving some useful object. As a help for stalling crashes, it seems about as useful as handing a cup of hot tea to a drowning man because the water happens to be cold.

The sponsors of this strange and elaborate gubbins do not seem to have noticed that a powerful rudder control will do the same thing, but will do it rather better. For example, if a stalled machine starts a spinning motion to the left, the application of a powerful rudder control to the right will stop the spin, will check the yaw, will bring the machine to a laterally-horizontal position, *and*, owing to the downward movement of the tail unit, to a temporarily horizontal position fore and aft. The stunt known as the "falling leaf" is an excellent example of this, since it reproduces many times consecutively the actual conditions in question; rudder alone is used in alternate directions under the "stick back" condition.

Having dealt at painful length with destructive criticism what about something constructive?

The stall being (until the advent of the Autogiro) an indelible feature of the aeroplane, must be dealt with as it is in working practice. I suggest that the practical way of ameliorating the dangerous conditions of the stall is two-fold:

(1) Making the stalled-crash subject a definite and important part of flying instruction:

(2) Providing powerful control *right down to* stalling speed.

The only point on this subject on which the scientists are nearly right is that a pilot in difficulties may easily *instinctively* do the wrong thing.

Only, as a matter of fact, it is not *instinctive*—though the word is good enough—it is purely a matter of training. For example again, a pilot with an engine failure tries to reach a field the machine cannot reach, or to clear a tree that it cannot clear. His training—or instinct—is that if you pull the stick back you go up. He knows perfectly well, subconsciously, that he cannot reach the field, but another part of his brain, reacting to that training, pulls that stick back. This is most decidedly the state of affairs governing the stalled crash, and, regarded as such, is most definitely easy to deal with in training.

If the trouble is "instinctive," the cure must also be "instinctive," and my own instructional methods used to be to try and instil a definite and separate emergency instinct into the pupil. This instinct, being mainly based on the necessity of avoiding stalling, can be formed on a sort of Coué idea of "When in trouble, bang your stick up against the dashboard, and think afterwards." By making a habit of switching off the engine (during dual instruction) at all sorts of unexpected moments, I found it very easy to induce pupils to push the nose hard down, *without thinking*, in the most unfavourable of situations. It is an almost infallible method of instilling the avoidance of the stall into a pupil, and though the violent push on the stick that I used to insist on became modified to a more reasonable push, the "instinct" for maintaining flying speed definitely overcame the "instinct" to hold the nose up. As I claimed at the start, the stalled crash is almost entirely psychological, and must be cured psychologically.

On the mechanical side I claim definitely that control beyond the stall as a serious study is of greatly exaggerated importance. But, control *right down to* the stall has more importance than might appear. For supposing, as frequently happens, control becomes feeble some ten miles an hour before the stall, then, if the pilot wishes, to glide at his very lowest speed he definitely risks passing stalling speed for lack of control. Further, should he then get into some of that panic state which inevitably means the "stick back" policy, this will be increased by the knowledge that, if he does push the stick forward, he must not only come unstalled, but must gain a further 10 m.p.h. before he has full control.

If, on the other hand, full control exists down to the stall, a mere forward flick on the stick restores both normal flight and full control.

The perfect, or nearly perfect, low speed control is a fairly simple matter, yet it seems to have had very little practical examination. The result is that the two most popular forms of lateral control at the moment are ones in which the main principles militate against perfect low speed control.

But in any case, the stall provides fundamental difficulties, not to be cured by any such methods as a clumsy lateral control, whose principles only operate on rare occasions.

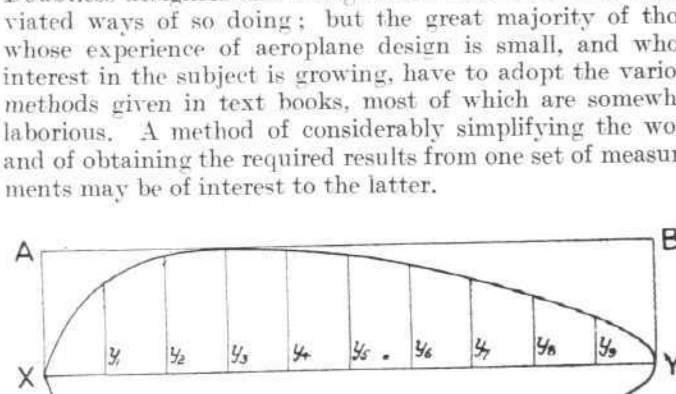
IN THE DRAWING OFFICE.

STREAM-LINE STRUTS.

Areas and Moments of Inertia.

By Lieut.-Col. J. D. BLYTH, late R.A.F.

IN the process of calculating the dimensions of a stream-line strut to take a given load, it becomes necessary to find the area and the least moment of inertia of its cross-section. Doubtless designers and draughtsmen have their own abbreviated ways of so doing; but the great majority of those whose experience of aeroplane design is small, and whose interest in the subject is growing, have to adopt the various methods given in text books, most of which are somewhat laborious. A method of considerably simplifying the work and of obtaining the required results from one set of measurements may be of interest to the latter.



Given the shape of the cross-section as in the figure, draw the longer axis XY, and complete the rectangle XABY so that AB is a tangent to the curve.

Then $l = XY$ = length of section.

$t = 2AX$ = thickness of section.

$\frac{l}{t} = F$ = fineness ratio.

Since the section is symmetrical about XY, XY is the neutral axis.

Now divide XY into 10 equal parts, and draw the ordinates $y_1, y_2, y_3 \ldots y_9$. Measure the lengths of these ordinates.

By making use of Simpson's First Rule, we can now find all we require.

A = area of section.
I = least moment of inertia of section.
k = corresponding radius of gyration.

$$\tfrac{1}{2}A = \frac{l}{30}\left\{4\,(y_1 + y_3 + y_5 + y_7 + y_9) + 2\,(y_2 + y_4 + y_6 + y_8)\right\}$$

$$\tfrac{1}{2}I = \frac{l}{30}\left\{4\,(y_1^3 + y_3^3 + y_5^3 + y_7^3 + y_9^3) + 2\,(y_2^3 + y_4^3 + y_6^3 + y_8^3)\right\}$$

$$k = \sqrt{\frac{I}{A}}$$

If required, the greatest moment of inertia may be found in the same way. In this case, the neutral axis is drawn perpendicular to XY through the centre of area of the section. This lies on XY, its distance from the nose X being $\bar{x}$, where

$$\bar{x} = \frac{l}{10}\left\{\frac{4\,(y_1 + 3y_3 + 5y_5 + 7y_7 + 9y_9) + 2\,(2y_2 + 4y_4 + 6y_6 + 8y_8)}{4\,(y^1 + y_3 + y_5 + y_7 + y_9) + 2\,(y_2 + y_4 + y_6 + y_8)}\right\}$$

To some, at first sight, these expressions may appear a little cumbersome, but the cubes can be looked up in a table, and the rest involves no higher mathematics than a little addition, multiplication, and division.

For standard stream-line struts these expressions may be further simplified, as for any particular thickness of strut, the values of y_1, y_2, y_3, etc., remain the same for every fineness ratio.

Giving the symbols l, t, F, A, I, k, and $\bar{x}$ the same meanings as before :—

$$l = Ft$$

For standard stream-line struts :—

$$\begin{aligned} y_1 &= 0\cdot375t \\ y_2 &= 0\cdot475t \\ y_3 &= 0\cdot5t \\ y_4 &= 0\cdot49t \\ y_5 &= 0\cdot47t \\ y_6 &= 0\cdot425t \\ y_7 &= 0\cdot365t \\ y_8 &= 0\cdot275t \\ y_9 &= 0\cdot19t \end{aligned}$$

The tail is rounded off, the radius being $0\cdot1t$. We now get :—

$$\begin{aligned} A &= 0\cdot725Ft^2 \\ I &= 0\cdot044Ft^4 \\ k &= 0\cdot246t \\ \bar{x} &= 0\cdot449Ft \end{aligned}$$

If these values are plotted for a number of values of t, and such values of F as are being used, the required dimensions of a section for any value of A, I, or k can be read off at once.

TECHNICAL LITERATURE.

A.R.C. REPORTS.

INTERNATIONAL TRIALS. REPORT ON AEROFOIL TESTS AT NATIONAL PHYSICAL LABORATORY AND ROYAL AIRCRAFT ESTABLISHMENT. R. & M. No. 954 (Ae. 173). (46 pages and 7 diagrams.) May, 1925. Price 2*s.* net.

Acting on a suggestion made by the Director of Research, the Aeronautical Research Committee decided in March, 1920, to institute comparative model tests in as many as possible of the aerodynamic laboratories of the world. It was thought that such tests, in which the same models would be tested successively by all laboratories, would supply valuable information which had not previously been available. The aim of wind-tunnel experimental work is to obtain reliable estimates of the forces which would be experienced by bodies moving at specified speeds through still air of infinite extent ; but in practice it is necessary to hold the model stationary and to generate a flow of air past it, and measurements made in this way are in some degree open to question, in that the forces imposed upon the model may be affected (1) by the limited extent of the air stream in which they are placed and (2) by the turbulence which can never be entirely eliminated. The results must, furthermore, depend to some extent upon the methods adopted for connecting the models to the measuring apparatus. Different methods are adopted in different countries, and wind tunnels of varying size and design are employed ; thus there is some uncertainty as to the extent to which a comparison can be made, *e.g.*, between different aerofoils tested in different countries, and this uncertainty, it was thought, would be reduced if comparative figures were available from tests upon the same models.

The tests finally decided upon included the determination of lift, drag, and C.P. for a standard aerofoil model of R.A.F. 15 section at various angles of incidence. The tests carried out in Great Britain are reported in the present paper (R. & M. 954), and the results plotted in the appended figures. The results should be of general interest to all establishments or firms which use wind tunnels for making experiments on aerodynamic models, and they show the amount of variability that is obtained between the results on the same model tested under a variety of conditions. In general, the agreement between the N.P.L. and the R.A.E. wind tunnels may be considered satisfactory with the exception of one of the N.P.L. wind tunnels, namely, the 7-ft. No. 1. It is further to be noted that the results on the 4-ft. tunnels, when corrected for tunnel-wall interference by the Prandtl theory, are in very good agreement with the 7-ft. tunnel results except in the case of the N.P.L. 4-ft. No. 2 tunnel.

THE LATERAL CONTROL OF STALLED AEROPLANES. GENERAL REPORT BY THE STABILITY AND CONTROL PANEL. R. & M. No. 1000. September, 1925, 2*s.* net.

The problem of obtaining adequate lateral control of aeroplanes has occupied the attention of research workers and designers for a number of years and it is now certain that the problem is sufficiently understood to permit of a satisfactory solution in the case of the normal design of aeroplane as it is known to-day.

The existing form of lateral control is the aileron, which introduces a moment tending to turn as well as to bank the aeroplane, and some device has long been needed which would give the required rolling moment without the accompanying yawing or turning moment. The most satisfactory means yet devised for obtaining this type of control is the slot-and-aileron described in R. & M. Nos. 916 and 968. Smaller improvements in other directions have resulted with the use of increased rudder control, the full-scale tests of which are described in R. & M. No. 972, and by the use of differential ailerons as described in R. & M. No. 964.

The present report commences with a general statement of the problem of the lateral control of stalled aeroplanes, and outlines the general principles of satisfactory control. The data required and the methods of analysing the data obtained from models are next discussed in some detail, and an account is given of certain step-by-step calculations made for the motions following from certain initial disturbances. The various devices tried for the improvement of lateral control are also described in some detail, and complete references are given to the whole of the work bearing on the investigation.

The object of the Aeronautical Research Committee in initiating the experiments here discussed has been to reach a thorough understanding of the principles governing control of stalled aircraft in any circumstances, and to lay the foundations of precise information upon which can be built up routine methods of predicting, from an inspection of the design, the degree of controllability to be expected in any aeroplane. It is considered that the first of these

objectives has, in a measure, been attained, but the second has not and cannot be attained except as the result of laborious and lengthy experiments, which have yet to be undertaken.

The fore-and-aft control of stalled aeroplanes yet remains to be studied in detail. This it is proposed to do as soon as possible. From practical experience there is no doubt that the conventional aeroplane of the present day can be controlled fore-and-aft when stalled to moderate angles, but considerably more study of the problem is required before it will be practicable to experiment on the problem of landing whilst in the stalled state.

These Reports can be obtained from H.M. Stationery Office, Kingsway, W.C. 2, and from Branch Offices.

AMERICAN NATIONAL ADVISORY COMMITTEE REPORTS.

Report No. 214, by Professor E. P. Warner, of the Massachusetts Institute of Technology, is entitled "Wing Spar Stress Charts and Wing Truss Proportions." In the introduction it is pointed out that, although the coming of the thick aerofoil section has somewhat decreased the number of aeroplanes designed with continuous wing spars externally supported at several points, the type has not by any means disappeared, and the calculation of continuous beams is still making heavy inroads upon the time of the designer. The curves given and described in this report have been prepared with the object of reducing the labour involved in such calculations. A series of charts have been calculated, giving the bending moments at all critical points, and the reactions at all supports for such members. Using these charts as a basis, calculations of equivalent bending moments, representing the total stresses acting in two-bay wing trusses of proportions varying over a wide range, have been determined, both with and without allowance for column effect. This leads finally to the determination of the best proportions for any particular truss or the best strut locations in any particular machine. The ideal proportions are found to vary with the thickness of the wing section used, the aspect ratio and the ratio of gap to chord.

Report No. 217, by Dr. Max Munk, is entitled "Preliminary Wing Model Tests in the Variable Density Wind Tunnel of the N.A.C.A.," and contains the results of a series of tests with three wing models. By changing the section of one of the models and painting the surface of another, the number of models tested was increased to five. The tests were made in order to obtain some general information on the air forces on wing sections at a high Reynolds Number, and in particular to make sure that the Reynolds Number is really the important factor, and not other things like the roughness of the surface and the sharpness of the trailing edge. The tests described seem to indicate that the air forces at a high Reynolds Number are not equivalent to respective air forces at a low Reynolds Number (as in an ordinary atmospheric wind tunnel). The drag appears smaller at a high Reynolds Number, and the maximum lift is increased in some cases. The roughness of the surface and the sharpness of the trailing edge do not materially change the results, so that it is felt that tests with systematic series of different wing sections will bring consistent results, important and highly useful for the designer.

Copies of these reports can be obtained from the Superintendent of Documents, Government Printing Office, Washington, D.C., U.S.A.

VERSLAGEN EN VERHANDELINGEN VAN DEN RIJKS-STUDIEDIENST VOOR DE LUCHTVAART—Deel III.

Part III of the Reports of the Aeronautical Research Institute of Amsterdam contains a good deal that is of interest to British aeronautical engineers and designers. The book is, of course, published in Dutch, but each report is preceded by a summary in French, English and German, and as the subject matter of the report is familiar and diagrams and tables are more or less a universal "language," there should not be any great difficulty in following the general sense of the various reports and the results arrived at.

Report A.33 deals with experiments on the pressure distribution on the fuselage of an aeroplane model, tested with a thick wing resting directly on its upper surface, and also tested without the wing. The tests show the influence on the air flow over the fuselage of a thick wing so placed. Plottings are given both for the fuselage by itself (*zonder draagvlak*) and with the wing in position (*met draagvlak*).

Report No. A.58 gives a nomogram for the correction of incidence and drag of model aerofoils tested in an airstream of finite dimensions, and this nomogram is directly applicable to making the necessary corrections to model tests in the tunnel.

In Report A.77 experiments carried out on the pressure drop in an air current, caused by the metal gauze, used to represent radiators, are described, and the results given.

Report A.96 describes experiments with and results obtained from a preliminary investigation of the influence of a rotating cylinder placed in the leading edge of an aerofoil. These tests have already been described in FLIGHT (January 15, 1925).

Space does not permit of a detailed reference to the rest of the reports, but an indication of their nature is provided by the titles, which are as follows :—M.14A : Experiments on the protection against humidity of wooden aeroplane parts by means of protective coatings of oil varnish. V.79 : Photographic time studies of aeroplane paths. A.92 : Experiments on the cooling power of two different radiators for the Fokker C.IV. A.76 : Model experiments on modifications of Fokker C.IV biplane. The latter report contains some interesting data on wings of various section and plan form as fitted to the fuselage of the C.IV.

Copies of the Report can be obtained from Messrs. Gebr. Cleeff, 28; Spui, The Hague, Holland.

PISTON TEMPERATURES AND HEAT FLOW IN HIGH-SPEED PETROL ENGINES.

Under above title a very interesting paper was read by Professor Gibson, D.Sc., of the University of Manchester, before the Institution of Mechanical Engineers, on January 22, 1926. The paper dealt in the main with the results of the measurements of piston temperatures made by the lecturer on the cylinders of various high-speed petrol engines during the past seven years. A number of the measurements were made at the Royal Aircraft Establishment, and the data obtained in these particular tests, along with the methods of obtaining the temperature readings, have been published in Report No. 13, L.A.S.C., May, 1918, of the Advisory Committee for Aeronautics.

The results of the measurements and calculations outlined in the paper led to the following general conclusions :—

(1) Under normal operating conditions, at full load, the temperature at the hottest point of an aluminium alloy piston of 100 mm. diameter, working in an aluminium air-cooled cylinder of good design, varies from 210° to 250°, depending on the design of the piston and the composition of its alloy. This is with a clearance (cold) of about 0·025 in. With such a clearance the drop in temperature between the edge of the piston crown and the cylinder wall is from 25° C. to 30° C. An increase in the piston clearance increases its temperature.

(2) From a thermal point of view there is little to choose between most of the usual aluminium alloys. The difference in temperature between the best and the worst is only about 25° C. With the exception of the alloy containing 8 per cent. Cu and 1 per cent. Mn, all have very nearly the same conductivity at 200°, and these all give similar results in a piston. The Cu–Mn alloy has a lower conductivity and gives a hotter piston. It should be noted that if this alloy is annealed at 450° C. for a short time, its conductivity becomes as high as that of the other alloys and its behaviour in a cylinder would presumably be the same.

(3) A cast-iron piston of normal design and of 100 mm. bore has a maximum temperature of about 440° C. under the same conditions of operation. At medium compression ratios (about 4·7) and at 1,800 r.p.m. it develops some 6 per cent. less power than a good aluminium piston and requires a greater petrol consumption (about 8 per cent.) per brake horse-power. The relative advantage is, however, likely to depend on circumstances. Thus, if the compression ratio is increased, detonation will first make its appearance in the cylinder fitted with the cast-iron piston, and a cylinder which would detonate violently with a cast-iron piston might work perfectly satisfactorily with an aluminium piston. Under these conditions the benefit of the aluminium piston would be much more pronounced. On the other hand, with a very low compression ratio the relative effect would not be expected to be at all pronounced. Recent experiments by the author on a $3\frac{1}{2}$-in. water-cooled cylinder with a compression ratio of 4·26 fitted with alternative pistons show that the improvement caused by the aluminium piston does not exceed some 2 per cent.

(4) The design of the piston affects its maximum temperature appreciably. The best piston examined has no ribs and a comparatively thin centre, the thickness of the crown being roughly proportional to the radius. This piston is some 20° cooler than one of the same weight but of a heavily-ribbed design.

(5) Perforating the skirt of the piston increases its temperature. The saving in weight is so small that such perforations are not to be recommended.

(6) The highest piston temperatures are attained with the weakest mixture capable of giving maximum power.

(7) The temperature of the piston appears to be only very slightly affected by the compression, within the limits of the experiments, being slightly less with the higher compression ratios.

(8) The effect of spark advance on piston temperature is not very pronounced, the highest temperatures, however, being obtained with the minimum spark advance.

(9) In a piston of the slipper type, in which the gudgeon-pin bosses are carried by lugs joining the piston crown, a considerable amount of heat is transmitted down these lugs, and the temperature gradient across the crown is much less than in the normal type of skirt piston. At the same time, owing to the reduced bearing surface, the drop in temperature between the edge of the piston and the wall is greater than in a skirt piston.

(10) In an air-cooled cylinder the hottest point of the piston is not at the centre, but at a point nearer the hottest side of the wall. Even in a water-cooled cylinder the sparking-plug may have a very marked heating effect on the wall in its vicinity, and consequently on the piston. In an extreme case the temperature at the edge of the piston nearest the sparking-plug may even be greater than that at the centre of the piston.

(11) Assuming that the heat transference from a hot gas to a metal surface per second per unit area equals $\epsilon\theta^2$, where θ is the difference of temperature in degrees Centigrade, the semi-amplitude of the cyclical fluctuation of surface temperature is given by—

$$a = \frac{e[(T_1 - \theta_0)^2 - (T_2 - \theta_0)^2]}{2\sqrt{2\pi n\rho sk}}$$

For the piston and combustion head surfaces, e has a value which varies from about $3 \cdot 6 \times 10^{-6}$ in gas engines of 6 to 12 in. diameter at speeds in the neighbourhood of 200 r.p.m. to $11 \cdot 0 \times 10^{-6}$ in high-speed petrol engines, at about 2,000 r.p.m. These values are in C.G.S. units. The corresponding values expressed in C.H.U. per sq. ft. per min. are $4 \cdot 4 \times 10^{-4}$, and $13 \cdot 5 \times 10^{-4}$.

(12) In a high-speed petrol engine at 2,000 r.p.m. the fluctuation of temperature in the surface of the piston, if of aluminium, is of the order of $\pm$ 5° C.

(13) In a high-speed petrol engine working on the weakest mixture capable of giving maximum power and with an air/petrol ratio in the neighbourhood of 13·5: 1, the heat given to the piston and flowing to the walls is approximately 3·5 per cent. of the heat of combustion of the fuel. When account is taken of the heat dissipated from the under side of the piston, it would appear that the total heat given to the piston is sensibly the same fraction of the heat supply as that found in slow-speed gas-engine tests.

(14) When burning occurs in an aluminium piston this is probably due ultimately to a local breakdown of lubrication, following overheating to a temperature which would not, however, in itself prove destructive.

METALLURGY

"It is impossible to predict the extent to which the use of alloy steels may develop and become of still further importance to the world. Research in this direction is showing that the possibilities of alloy steels are as yet exploited very incompletely; the total field is of enormous *extent, and by far the greater part is still unexplored.*" This paragraph, from the preface of Sir Robert Hadfield's book entitled, "Metallurgy and its Influence on Modern Progress," published by Chapman and Hall at 25*s*. net (postage 9*d*.), is particularly significant in its relation to aircraft manufacture at the present time, when nearly every aircraft firm in Great Britain is turning its attention to the problems of all-metal construction. The part played by Sir Robert Hadfield in evolving alloy steels is too well known to need enlarging upon here, and it has been truly said that Sir Robert holds a place in the "Age of Alloys" similar to that occupied by Bessemer in the "Age of Steel."

Sir Robert Hadfield's book is not in any way a text-book on metallurgy, but it *is* a most fascinating history, to technical and non-technical alike, of human endeavour in the field of metallurgical science. In the space at our disposal it is useless to attempt adequately to review this extraordinarily interesting work, a more extensive review of which we hope to give in another issue; but a very brief outline of its contents may serve to indicate the wide field covered, even if it cannot hope to convey the charm of the style in which the book is written.

The first part of Sir Robert Hadfield's book is historical, and deals with the birth of science, the rise of steam, and the twentieth century. In Part II, which is entitled "Metallurgy," the author treats of such subjects as the importance and antiquity of iron, carbon in simple and alloy steels, the rise and importance of alloy steels, manganese steel, silicon steel, heat treatment and micro-structure of steel, and application of special steels. A large section of the book is devoted to the subject of fuel economy, and another large portion, Part IV, to education and research; while in the last section, Part V, the author takes a peep into the future. The work is profusely illustrated by photographs, reproductions of engravings, and diagrams, and is one which all interested in metallurgy should make a point of obtaining.

CORRESPONDENCE

In order to leave as much space as possible for new articles in THE AIRCRAFT ENGINEER each month, letters dealing with the various points raised will be published in the correspondence columns of FLIGHT week by week. Such letters, referring to the publication of and articles appearing in the first of our monthly technical supplements will be found in FLIGHT of February 11 (from Mr. T. O. M. Sopwith, Mr. W. S. Shackleton, Mr. Oswald Short, Capt. de Havilland, Mr. C. C. Walker, Mr. C. H. Dowty, Mr. H. P. Folland, Mr. F. Sigrist, Mr. W. O. Manning, and Capt. A. S. Keep) and of February 18 (Mr. C. C. Walker and Maj. F. M. Green).

ERRATA

Although a correction was published in the issue of FLIGHT of February 4 of an error which crept into the article by Mr. Handley Page in THE AIRCRAFT ENGINEER of January 28, it is thought that some readers may have missed this, and consequently the corrections are given again here. In Table 3 on p. 3 the last two divisions were headed flap angle −10° and flap angle −20°. These should have read flap angle +10° and flap angle +20° respectively. In the graph published in the top right-hand corner of p. 3 the positive signs were correctly given.—ED.

THE BEARDMORE W.B. XXVI

A Machine with Excellent Controllability

IN our issue of August 20, 1925, we published the general arrangement drawings and a brief description of the Beardmore W.B. XXVI two-seater fighter, designed and constructed by William Beardmore and Co., Ltd., of Glasgow, for the Government of Latvia. Further particulars of the machine, as well as photographic illustrations, were given in our issue of December 31, 1925. The W.B. XXVI has now been put through its flying tests, and although detailed performance figures may not be given, it is possible to state that recently, when the machine was being tested by Captain A. N. Kingwill, the firm's chief test pilot, the speed range was found to be no less than three to one, which must certainly be regarded as extraordinarily good.

Although not in the nature of performance tests in the ordinary sense of the term, it is interesting to learn that the manœuvrability and structural strength of the W.B. XXVI are very good indeed. In the course of the test flights, Capt. Kingwill dived the machine at over 200 m.p.h., and made a loop immediately on flattening out from the dive. In spite of the very high stresses which must have been imposed upon the machine, no trouble was experienced, and no failure of any structural part occurred. Capt. Kingwill then gave a display of the stunt known as "the falling leaf," and the machine was also rolled and spun. The next tests to which the machine was put were high-speed cornering with the angle of bank approaching the vertical.

After this Capt. Kingwill proceeded to give what was considered to be perhaps the most important demonstration of all. Keeping the machine along a horizontal path the engine was gradually throttled down until the stalling angle was reached. The throttle was then closed and the control stick pulled right back. The machine assumed an attitude of approximately 60 degs. with the horizontal, and commenced to sink on an even keel. By way of showing that the machine was still under control in this fully stalled condition, Capt. Kingwill rocked it laterally and pitched it fore and aft. A similar demonstration was then given with the engine full on. Flying horizontally at about 1,000 ft. altitude, Capt. Kingwill commenced to climb almost vertically, until the machine stalled and started to fall tail first. The engine was full on, and it was noticed that the nose of the machine merely dropped slightly and the machine commenced to sink. The angle of the fuselage as before was about 60 degs. to the horizontal, and it was again demonstrated that all the controls were fully operative. Considering that the Beardmore W.B. XXVI is not fitted with any unusual forms of lateral controls, this achievement is one of which the designer, Mr. W. S. Shackleton, may well be proud.

A MANŒUVRABLE MACHINE: The Beardmore W.B. XXVI has recently been put through some severe performance and controllability tests, from which it has emerged with flying colours.

Technical data relating to the Beardmore W.B. XXVI have already been published in FLIGHT in the articles referred to above, and a technical description of the undercarriage, which is of unusual design, will be found in THE AIRCRAFT ENGINEER supplement. The machine has repeatedly been taxied at high speed on rough ground without trouble.

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THE WORLD'S AIRWAYS*

UNDER the title of "A Commercial and Historical Atlas of the World's Airways," an ambitious handbook has just been issued and compiled by Francis J. Field, Ltd., of Sutton Coldfield (Birmingham), a name, no doubt, well known to some of our readers in connection with that latest hobby, Air Mail Philately, or "Aero-philosemy." We say ambitious, for we fully appreciate the extreme difficulty experienced in obtaining anything like complete and reliable data regarding commercial air services, special or experimental flights, &c., that have taken place in various parts of the world. At the outset, we must say that the publishers of this work are to be congratulated on the thoroughness and completeness of the information they have got together between its sky-blue covers.

In a Foreword by Sir W. Sefton Brancker, the Director of Civil Aviation, says: "I wish the best of luck to this enterprising little publication. It is of importance that the general public should know what is being done by the various nations of the world in the development of Air Transport. This 'Atlas' should give a vivid and comprehensive view of this new activity, which will be of such vast importance to the British Empire in the future."

We very much regret that we have not the space to spare for a detailed review of the contents of this "Atlas," and we can only give just a brief outline of what is given. In the main, it contains a large number of maps of various countries, or sections thereof, showing not only the air routes, but the date on which the first flight was made. Accompanying these maps is some descriptive matter, briefly giving the air history of that country. Then there are sections dealing with the following subjects:—"Aircraft: The Servants of Commerce; Insurance against Air Risks; Forwarding Goods by Air; How to Use the Air Mails; Countries Issuing Special Stamps; Air Post Terms; Some Long-Distance Flights; The Balloon Posts of Paris; Collecting Souvenirs of the Air;" &c.

Thus, it will be seen that in spite of the fact that this work is the first of its kind, it is remarkably comprehensive, and the suggestions for improvements asked for by the publishers will, we think, require some finding.

* "A Commercial and Historical Atlas of the World's Airways." Francis J. Field, Ltd., Birmingham, Price 2s. 6d. net.

THE AIR ESTIMATES, 1926-27

A Net Increase of £486,990

THE Air Estimates for the financial year 1926-27 were issued last week, and show a net increase over last year's Estimates of £486,990. The gross estimate is £20,864,500, but appropriations-in-aid are expected to reach the value of £4,864,500, thus reducing the total to £16,000,000, as compared with a net estimate of £15,513,010 for last year. Out of the net total, non-effective services account for £245,000, as compared with £143,000 the previous year. Personnel shows a decrease from 36,000 to 35,500.

Effective services are estimated to require the following amounts :—

Votes.		Net Estimates. 1926-27.	1925-26.
		£	£
1	Pay, etc., of R.A.F. ..	3,405,000	3,412,000
2	Quartering, stores (except technical), supplies and transport ..	1,507,000	1,459,000
3	Technical and warlike stores (including experimental and research services) ..	6,091,000	5,650,000
4	Works, buildings, and lands	2,347,000	2,572,000
5	Medical services.. ..	209,000	204,000
6	Educational services ..	432,000	486,000
7	Auxiliary and Reserve Forces	406,000	348,000
8	Civil aviation	462,000	357,010
9	Meteorological and miscellaneous effective services	135,000	131,000
10	Air Ministry	761,000	751,000
	Total effective services	£5,755,000	£15,370,010
11	Non-effective services (half-pay, pensions, and other non-effective services)	245,000	143,000
	Total effective and non-effective services ..	16,000,000	15,513,010
	Total net increase ..	£486,990	

Personnel

The grouping and numbers of personnel this year are as follows :—

Air Officers : Vote 1, 19 ; Vote 6, 3 ; Vote 7, 1 ; Vote 10, 12 ; total 35.

Other Commissioned Officers : Vote 1, 2,957 ; Vote 3, 30 ; Vote 5, 210 ; Vote 6, 125 ; Vote 7, 48 ; Vote 10, 130 ; total 3,500. *Cadets* : Vote 6, 120 ; total 120. *Warrant Officers* : Vote 1, 284 ; Vote 3, 1 ; Vote 5, 13 ; Vote 6, 36 ; Vote 7, 10 ; Vote 10, 1 ; total 345. *Non-commissioned Officers* : Vote 1, 4,158 ; Vote 3, 3 ; Vote 5, 205 ; Vote 6, 352 ; Vote 7, 78 ; Vote 10, 4 ; total 4,800. *Aircraftmen* : Vote 1, 21,184 ; Vote 5, 618 ; Vote 6, 784 ; Vote 7, 214 ; total 22,800. *Apprentices* : Vote 1, 400 ; Vote 6, 2,800 ; total 3,200. *Enlisted Indian personnel in Iraq* : 700 ; total 700. Total number to be voted : 35,500. It is pointed out that this number includes Army personnel attached to the Royal Air Force.

Financial Expenditure

Under Vote 1 the summarised figures are as follows : Pay and personal allowances of officers, £1,300,000 ; pay and personal allowances of airmen, £2,406,000 ; marriage allowance, £105,000 ; miscellaneous allowances, £19,000 ; civilians, £799,000 ; service gratuities to airmen on discharge, etc., £26,500 ; recruiting staff and expenses, £11,500. Gross total, £4,667,000. Appropriations-in-aid are expected to reach £1,262,000, which will reduce the net total under this vote to £3,405,000, a net decrease of £7,000.

Under Vote 2 the summarised figures are : Lodging allowances and billeting, £123,000 ; barrack services, £62,000 ; fuel and light, £246,000 ; general stores, £226,000 ; clothing, £293,000 ; provisions and horses, £868,000 ; transport, £450,000. Gross total, £2,268,000. Appropriations-in-aid amounting to £761,000 will reduce this figure to £1,507,000' a net increase of £48,000.

One of the most interesting is Vote 3, technical and warlike stores, which provides for the following amounts : Aeroplanes, seaplanes, engines and spares, £5,351,000 ; experimental and research establishments, £95,000 ; Aeronautical Inspection Department, £132,000 ; aircraft technical and warlike stores, £194,000 ; armament and ammunition, £412,000 ; electrical stores, £307,000 ; miscellaneous research, £241,000 ; miscellaneous material, £309,000 ; balloons and hangars, £23,000 ; mechanical and other transport, £252,000 ; petrol and oil, £496,000 ; rewards to inventors and miscellaneous claims (including war liabilities), £57,000 ; purchase of airships, £30,000 ; airship development, £332,000. Gross total, £8,231,000. Appropriations-in-aid to the value of £2,140,000 are expected to reduce the net total of Vote 3 to £6,091,000, a net increase of £441,000.

The summarised statement under Vote 4, Works, Buildings and Lands, is as follows : Staff for works services, £235,000 ; new works, additions and alterations, amounting to £2,000 each and upwards, £1,790,000 ; ditto under £2,000 each, £113,000 ; ordinary repairs, renewals and maintenance, £609,000 ; grants in aid of works, £22,000 ; purchases of lands and buildings, £140,000 ; rents, compensations, and reinstatements, £50,000 ; incidental expenses of Air Ministry estates, £15,000 ; provision of telephone and telegraph services, £1,000 ; miscellaneous works services, £13,000 ; stores and plant for works (net), £19,000 ; machine tools, £24,000. Gross total, £2,993,000. Deduct for probable under-spending £150,000 and appropriations-in-aid, £496,000. Net total £2,347,000, a net decrease of £225,000. It is pointed out, however, that further provision for works services is included under Votes 3, 8 and 9.

The Medical Services, Vote 5, are estimated to require £209,000, as follows : Pay and personal allowances of officers, £133,000 ; pay and personal allowances of airmen, £114,000 ; nursing service, £32,000 ; fees, etc., to civil medical practitioners, £3,500 ; civilians employed in hospitals and sick quarters, £10,200 ; medical stores and supplies, £14,000 ; payments to hospitals, £35,000 ; miscellaneous charges, £5,800. Gross total, £347,500. Appropriations-in-aid, £138,500. Net total, £209,000, a net increase of £5,000. The net total excludes the cost of the headquarters staff of the Director of Medical Services, and of the medical staff engaged on recruiting, research and Reserve duties, provision for which is made in Votes 10, 1, 3 and 7 respectively.

Educational services (Vote 6) are estimated to require the following amounts : Royal Air Force Staff College, Andover, £13,500 ; R.A.F. Cadet College, Apprentices Wing, Cranwell, £164,700 ; School of Technical Training (Apprentices), Halton, £219,100 ; general and vocational training of airmen, £46,700 ; miscellaneous educational services, £4,000. Gross total, £448,000. Appropriations - in - aid, £16,000. Net total, £432,000, a net decrease of £54,000.

Vote 7, Auxiliary and Reserve Forces, is estimated to require £406,000, as follows :—*R.A.F. Reserve :* Pay and personal allowances of permanent staff, £4,000 ; pay and personal allowances during training, £13,000 ; retaining fees and reserve pay, £142,800 ; capitation payments to civil companies for training, etc., courses, £135,000 ; miscellaneous expenses, £1,300. *Special Reserve and Auxiliary Air Force :* Pay and personal allowances of Headquarters staff, £6,300. *Special Reserve :* Pay and personal allowances of Regular staff, £29,600 ; training, etc., £2,400 ; miscellaneous expenses, £1,000. *Auxiliary Air Force :* Pay and personal allowances of Regular staff, £18,500 ; grants to county associations, £39,000 ; training, etc., £5,200 ; miscellaneous expenses, £4,400. *University Air Squadrons :* Pay and personal allowances of R.A.F. instructors, £2,900 ; miscellaneous expenses, £900. *Voluntary Aid Detachments :* Miscellaneous expenses, £200 ; gross total, £406,500 ; appropriations-in-aid, £500 ; net total, £406,000 ; net increase, £58,000.

Civil Aviation, Vote 8, is estimated to require the following amounts :—Civil aviation aerodromes, £30,500 ; air routes surveys, etc., £30,000 ; technical equipment, £14,000 ; works, buildings and lands, £216,500 ; miscellaneous, £2,000 ; civil aviation subsidies, £180,000 ; gross total, £473,000 ; appropriations-in-aid, £11,000 ; net total, £462,000 ; net increase, £104,990.

It is estimated that Vote 9, Meteorological and Miscellaneous Effective Services, will require the following amounts :— Compensation for losses, etc., £12,000 ; losses by exchange, etc., £100 ; medals, £100 ; telegraphic and telephonic charges and postage abroad, £58,300 ; meteorological services, £77,000 ; miscellaneous, £18,000 ; allowances to ministers of religion, £6,500 ; gross total, £172,000 ; appropriations-in-aid, £37,000 ; net total, £135,000 ; net increase, £4,000.

As in previous years, Vote 10 (the Air Ministry) is a large

one, amounting this year to £761,000 net, under the following subheads:—Salaries and allowances of the Air Council and Department of the Secretary, £319,990; salaries and allowances of the Department of the Chief of the Air Staff, £155,765; salaries and allowances of the Department of the Air Member for Personnel, £50,710; salaries and allowances of the Air Member for Supply and Research, £143,192; salaries and allowances of the Directorate of Civil Aviation, £14,467; salaries and allowances of the Meteorological Office, £48 948; pay of messengers, porters, etc., £27,204; contingent expenses, £1,724; gross total, £762,000; appropriations-in-aid, £1,000; net total, £761,000; net increase, £10,000.

The last Vote, No. 11, is for non-effective services, which are expected to require £245,000, as follows:—Awards to officers, warrant officers, non-commissioned officers and aircraftmen, £350; half-pay of officers, £3,500; service and disability retired pay and gratuities of officers and nurses, £168,000; pensions and gratuities to wounded officers, £700; service and disability pensions and gratuities—warrant officers, non-commissioned officers and aircraftmen, £31,500; pensions, gratuities and allowances to widows, children, etc., £12,600. Civil non-effective payments: Recurrent charges, £5,550; non-recurrent charges, £8,200; injury grants, £7,900; commutation of retired pay, wounds pensions, etc., £7,700; relief fund, £500. Gross total, £246,500; appropriations-in-aid, £1,500; net total, £245,000; net increase, £102,000.

As in previous years, the Air Estimates are accompanied by a memorandum by the Secretary of State for Air, in which Sir Samuel Hoare elucidates certain points. This memorandum is given in full below.

MEMORANDUM BY SECRETARY OF STATE FOR AIR

THE net air estimates submitted to Parliament for the coming year amount to £16,000,000, an increase of £487,000 on those of the current year. There is, however, a decrease of the gross estimates, owing to a reduction of that part of air expenditure which falls finally on the Middle East Vote in respect of Iraq, Palestine and Transjordan, and on Navy Votes in respect of the Fleet Air Arm. The comparison between the two years is shown in detail in the following table:—

	1925.	1926.	+ or —
	£	£	£
Net estimates	15,513,010	16,000,000	+ 486,990
Appropriations-in-Aid:—			
Middle East (Air and ancillary services) ..	3,116,700	2,921,500	— 195,200
Middle East (supplies to British and Indian troops on repayment and other recoveries)	448,300	299,800	— 148,500
Fleet Air Arm	1,320,000	681,000	— 639,000
Ordinary Appropriations-in-Aid	921,300	962,200	+ 40,900
Gross estimates	21,319,310	20,864,500	— 454,810

The decrease in the provision for the Middle East represents another stage in the progressive diminution of the British forces in Iraq and Palestine; its continuance depends on the absence of any serious set-back to the political stabilisation of those countries. The decrease on the Fleet Air Arm is mainly due to the non-recurrence of capital expenditure on new equipment; there is to be no diminution of the strength of the Arm in the coming year, but on the other hand the further increase to which reference was made last year has been postponed by agreement with the Admiralty.

The increase on the net estimates reflects the higher level of strength of the Home Defence Force; expansion has been proceeding during the current year, and although the actual development during the coming year will be less, the average requirements of this part of the Air Force over the year both in personnel and material are inevitable greater. But expenditure in this direction has been offset by all possible administrative economies, and the net total of some of the votes shows a decrease.

While, however, the gradual growth of the Air Force for home defence continues, the actual rate of expansion is decreased. This is a consequence of a decision of His Majesty's Government to relax, in view of the international and financial situation, the efforts which have hitherto been made to complete the authorised programme at the first possible date. When, in 1923, the then Government decided to increase the strength of the home defence force to 52 squadrons (39 regular) it was contemplated that this could be achieved by the year 1928. It had already become apparent, however, that the very complicated interlocking programme of land purchase, building, recruiting, training and equipment could hardly be completed before the year 1930. The effect of the recent decision is that in existing circumstances even this date need not be aimed at for completion of the programme, and that the advances towards it, in the next year or two at any rate, can be gradual and deliberate. This decision—which relates only to the rate of progress, not to the strength to be eventually attained—is open to review in accordance with the international situation, and in particular with the results of international discussions on disarmament. Apart from such contingencies, which are still in the future, the total of Air Estimates will necessarily rise considerably in future years. The slackening of the advance makes it possible to avoid in 1926 the substantial increase in expenditure which was impending, but the deferment is temporary.

Strength, Distribution and Employment of the Air Force.

During the past year the strength of the Air Force has been increased by two Regular squadrons, one Special Reserve squadron and four Auxiliary Air Force squadrons, and, apart from training units and establishments, is at present approximately equivalent to 61 squadrons, 56 of which are maintained on a regular basis.

Of the regular units 45 are organised on a squadron basis (in addition to two detached flights), the remainder being composed of 18 flights (numerically equivalent to about 9 squadrons) provided for service in the Fleet Air Arm, and two flights controlled by the Air Ministry for operation from coastal bases.

The distribution on a squadron basis is as follows:—

	Regular. Squadrons.	Regular. Flights.	A.A.F. & S.R. Squadrons.
Home	27	1	5
Iraq	8	—	—
India	6	—	—
Egypt, Palestine and Transjordan	4	—	—
Aden and Somaliland	—	1	—

The Home Defence Force now consists of 25 squadrons, including 1 Special Reserve and 4 Auxiliary Air Force. Considerable progress has been made in the preliminary arrangements for the formation of two additional squadrons, one Special Reserve and one Auxiliary Air Force, and it is proposed to form these two squadrons in the financial year 1926. The one new regular squadron which it is also proposed to add to the Home Defence Force during the year will, it is anticipated, become available by withdrawal from overseas.

The post of Air Officer Commanding Air Defences of Great Britain was instituted about a year ago with a small staff which has so far been engaged on preliminary work, the supervision of training, &c., with temporary headquarters at the Air Ministry. During the forthcoming year it is proposed to advance a further stage, and to place under this Command, which will shortly be moved from the Air Ministry, two new Headquarters which are to be formed for the control respectively of the Fighting and Bombing squadrons of the Home Defence Force. One of these Headquarters will be in substitution for an existing Group.

The strength of the Fleet Air Arm remains at 18 flights, the increase of four flights which it was proposed to effect in 1925 having been postponed, in conformity with a deferment of the completion of the aircraft-carrier for which they will be required.

The provision of squadrons for co-operation with the Army remains unchanged.

Following upon the settlement by the League of Nations of the northern boundary of Iraq, it is proposed to proceed with the scheme for the progressive reduction of the Imperial garrison in that country, provided that there are no untoward political developments.

Three squadrons continue to be maintained in Egypt, and a detached flight of three aircraft at Aden with one machine in reserve in Somaliland. One squadron is provided for Palestine and Transjordan, one flight of which is stationed in the former country and two flights allocated to Amman.

The effective use of aircraft in tribal control already demonstrated in Iraq, Transjordan and Somaliland, was further illustrated by the operations against the Mahsud on the North West Frontier of India in March and April, 1925. The conspicuous success of these operations in which aircraft alone were employed has been recognised by the Government of India. Aircraft have been employed within the last few weeks in a minor operation in the Nuba Mountains in the Sudan.

When I introduced the Air Estimates for 1925 I stated that it was proposed during the course of the year to undertake certain long-distance flights. One of these flights has already taken place, R.A.F. aircraft from Egypt having visited Nigeria, passing through Upper Egypt, the Soudan and French Equatorial Africa. The flight was an unqualified success, and valuable experience was obtained. Arrangements are complete for another R.A.F. long-distance flight in Africa; this will be from Cairo to Capetown and back, and the aircraft will leave Cairo in a few weeks' time. Further flights of a similar kind are in contemplation.

In July a flight of seaplanes from Malta visited Italy and returned the visit of a flight of Italian seaplanes to Malta which had taken place earlier in the year.

Personnel.

The decision to spread over a longer period the building up of the Home Defence Force has made it possible to maintain approximately stationary the numbers and cost of personnel during the coming year. Vote A (maximum numbers allowed) shows as compared with last year a slight decrease of 500 (mainly due to the substitution of civilian for service personnel) and Vote 1 (pay) shows a net decrease of £7,000. Further progress has been made in economising the use of officers, and provision is made for 208 airmen pilots as compared with 139 last year. Ex-officers are being appointed in a civilian capacity as recruiting officers, and this change, together with other economies, has allowed of a reduced provision for recruiting. Further progress has been made in the substitution of civilians for airmen, and the number of the former provided in Vote 1 increases by over 250. Difficulty has been experienced in obtaining the airmen clerks required, and the good type of boy obtained for training as aircraft apprentice has encouraged the Air Ministry to adopt a similar scheme for clerks. Provision is accordingly made for 96 boys under training as apprentice clerks. The reduction effected last October in the pay of new entrants—both officers and airmen—affects Air Estimates during the coming year comparatively slightly, but the saving will increase year by year.

The cost of the medical services will be approximately the same as last year, Vote 5 showing a saving of £8,000 on the gross total and an increase of £5,000 on the net total. The main reduction effected in the Estimate has been in the provision for medical services in the Middle East—a reduction which does not affect net Air Votes.

A saving of over £50,000 has been effected in the cost of educational services (Vote 6). This decrease is largely the result of a close investigation into the establishments of the two great training stations, Halton and Cranwell; the economies are administrative, and do not impair the training curricula. The number of apprentices at Cranwell is further reduced, newly entered aircraft apprentices being trained at Halton.

Reserve and Auxiliary Forces.

The development of the Reserve and Auxiliary Forces and of the two University "Air Squadrons" described below, is to be continued during 1926, and Vote 7 is accordingly increased by £58,000. The re-equipment of the civil flying schools with aircraft of modern type for the training of Reserve Officers is progressing, and the higher cost of this training is reflected in the provision. Now that the supplementary source of recruitment for the Reserve of Air Force Officers from amongst qualified pilots trained during the late war is practically exhausted, an experimental scheme has been launched for the enrolment of young men, and their training *ab initio* as pilots, in the Reserve. Provision is taken for continuing this scheme on a small scale during 1926.

A beginning has been made with the formation of Special Reserve and Auxiliary Air Force squadrons, and these squadrons will, as already mentioned, be further developed during the year. The intake of volunteers in the squadrons already formed varies considerably in the different localities, and the estimate under this head is consequently still somewhat tentative in character.

During the latter part of 1925 provision was made at the Universities of Oxford and Cambridge to enable members of those universities to obtain knowledge and experience of all matters connected with aviation. Although the term "Air Squadron" has been adopted for convenience of use, no unit organisation has been introduced, and all instruction is given individually in the form of courses which are both practical and theoretical. The object of these courses is to influence the flow of candidates for commissions in the R.A.F., the Air Force Reserve and the Auxiliary Air Force, to stimulate interest in air matters generally at the universities, and to promote and maintain a liaison with the universities in technical and research problems affecting aviation. Except in so far as the qualifications of members, independent of their connection with the "Air Squadrons," render them eligible and willing to enrol in one or other of the non-regular Forces, they will have no liability for Air Force service. In each "squadron" there is a Chief Instructor, who is, at Oxford, a professor of the university, and at Cambridge a wing commander of the Regular Air Force. In addition a regular officer and two airmen are attached to assist in the instruction of the members. The provision taken in Vote 7 for the two "squadrons" (pay, etc., of instructors and miscellaneous expenses) approximates to £4,000.

Technical Equipment.

A net increase of £441,000 is shown in Vote 3 (Technical Equipment and Research). The gross expenditure is, however, £350,000 less than that shown in the Estimates for 1925, Appropriations-in-Aid being down by £791,000. This decrease is due to the reduction in expenditure on account of the Middle East and the Fleet Air Arm.

The Vote includes provision for research and technical development (as shown in Appendix 2 of the Estimates) and for airships. These are separately referred to below. The remainder of the Vote is concerned with provision for the standard technical equipment of the Air Force and for the services of inspection, etc., allied thereto.

While additional expenditure of a capital kind on Technical Equipment in 1926 will not be heavy, the increased maintenance requirements of the expanded force must be taken into account. The circumstances make it unlikely that the liabilities for which provision is taken will fail to mature before the end of the year, and accordingly no lump sum deduction has been made for underspending as was done in 1925. It should be noted that the comparison between the figures in the individual sub-heads of the Vote for the two years are to this extent vitiated; for instance, on the main Sub-head A (Aeroplanes, Engines and Spares) the apparent decrease should be discounted by (say) £200,000.

Research and Technical Development.

Sub-head B of Vote 3 now comprises the out-station research and experimental establishments previously shown in Sub-head C, in addition to the Royal Aircraft Establishment at Farnborough. The estimate for this Establishment has been rearranged so as to show separately from the main organisation the cost of certain sections whose work is not directly connected with that of the Establishment, and which are merely located at Farnborough for convenience. Sub-head C (now comprising Aeronautical Inspection only) is excluded from Appendix 2 of the Estimates as this service is not in any sense peculiar to experimental work. Appendix 2, which can now be taken as showing with approximate accuracy the extent of research and experimental services, shows a net increase of £19,000.

This small increase is largely accounted for by the addition which it has been found necessary to make to the staff concerned with the stressing for airworthiness of service and civil aircraft, in order to avoid delay in carrying out work which the department is under statutory obligation to perform. The remaining expenditure is maintained at much the same level as in 1925. It has only been possible to achieve this result by careful adjustment, since research and technical development are active at the present time, and commitments tend to increase.

It may be mentioned that a number of experimental machines have been ordered embodying the principle of the Cierva Autogyro, of which a preliminary test was recently carried out at Farnborough. The offer of a prize for a helicopter which was announced some two years ago comes to an end on April 30 next; a number of entries have been received, but no machine has yet passed any of the tests. It has been decided to close down the attempt (initiated by the Ministry of Munitions during the war) to construct a helicopter in a Government Establishment, to the design of, and under the supervision of, Mr. Louis Brennan, C.B., whose distinguished abilities as an inventor have been often demonstrated in the past. In the present instance, I am advised by the Aeronautical Research Committee that, in spite of the great mechanical ingenuity of the apparatus, the progress made with the experiments does not warrant their continuance; I have felt compelled, with regret, to accept this advice.

Airships.

The present Estimates carry the programme initiated by the late Government into its third year. This programme is divided into two parts—(1) airship development under the direct control of the Air Ministry, including the construction of a 5,000,000 cubic ft. airship at the Royal Airship Works

at Cardington; and (2) construction of an airship of the same capacity by a private company at a cost of £350,000.

The Air Ministry programme has been considerably retarded by the break-away of the R.33 in April last. Although the resulting experience was of considerable value, the refit of the airship delayed the carrying out of the projected series of experimental flights until the latter part of 1925.

The programme was, however, then completed, this being the first occasion on which these particular full scale aerodynamic tests, to which all independent authorities have attached the greatest importance, have been carried out in this country or elsewhere. In addition an aeroplane was successfully released from and re-attached to the airship in flight, thus establishing the future possibilities of the employment of airships as aircraft carriers. This experiment was also the first of its kind that had been successfully carried out in this country.

In consequence of the urgent need for economy, it has been decided, whilst the main lines of the programme will be kept intact, to spread its completion over a longer period than was originally contemplated; a flight by one of the existing airships to Egypt, which was originally planned for 1926, will not now be carried out, since the experience to be gained by it, though desirable, is not considered essential; arrangements are being made for the disposal of all Air Force and civilian personnel whose services are not likely to be required for the next year or so; and Pulham Air Station is being put upon a care and maintenance basis. As the result of these economies, the net provision for all airship expenditure in current estimates is reduced to £335,000.

Works.

Vote 4 (Works, Buildings and Lands) shows a net decrease of £225,000 as compared with 1925. The provision directly attributable to purchase of land and erection of buildings for the Home Defence Air Force is £1,130,000 as compared with £1,280,000 in 1925; if the original programme of expansion had been adhered to these services would have shown a large increase. So far as major new works at Home Stations are concerned, the provision is confined very largely to the amount necessary to meet liabilities already incurred. New services account for £122,500 only out of a total provision of £1,579,100 for major new works at Home Stations.

In respect of Egypt provision is taken for the continuation of approved services and for certain urgent new services in accordance with the policy of gradual replacement of makeshift temporary accommodation by more satisfactory semi-permanent buildings.

The provision for works services in Palestine, Transjordan and Iraq shows a reduction of £79,300 as compared with 1925.

As in the Estimate for the present year, and in accord with the view recently expressed by the Public Accounts Committee, a lump sum deduction has been superimposed on the gross total of the Vote, in order to discount the delays which frequently affect Works expenditure under contract.

Civil Aviation.

The provision for expenditure in connection with Civil Aviation shown under Vote 8 covers as in former years the maintenance of the airport of London at Croydon and the aerodrome at Lympne, ancillary services (other than meteorology) on the regular air routes, operational experiments and the supply of technical equipment for these purposes.

The amount of the subsidy payment to Imperial Airways Ltd. in respect of their European services is unchanged, but the terms of the Agreement dated May 15, 1924, have been modified by a supplemental agreement dated December 18, 1925, and published as a white paper (Cmd. 2574), to provide for the conversion of the minimum mileage requirement of 1,000,000 miles per annum into an annual "equated" horse-power mileage requirement of 452,000,000 horse-power miles.

With a view to the eventual establishment of a weekly civil air transport service between Egypt and India, an agreement has also been entered into with Imperial Airways Ltd. for the operation of a regular fortnightly air service with three-engined machines between Egypt and Basrah via Baghdad and between Basrah and Karachi. The maximum annual subsidy payable to the company under this agreement is £93,600. The service should be commenced not later than January 1, 1927. This agreement will also be published shortly as a white paper. Provision has been made for payment of £30,000 for the subsidy likely to accrue up to March 31, 1927, and also for a capital expenditure of £31,500 for the establishment of the necessary ground organisation and ancillary services for this air route.

A sum is again included for the financial assistance of a limited number of light aeroplane clubs, five of which have been approved under the terms of the Air Ministry scheme, and have commenced operations during the past year: the headquarters of these clubs are in London, Leeds, Birmingham, Newcastle-on-Tyne, and Manchester. It is expected that a sixth club will be approved in due course.

The enlargement and improvement of the airport of London at Croydon has been long in contemplation, and its need was emphasised by the Colefax Report (Cmd. 2351); but it has been delayed by causes over which the Air Ministry had no control. Now that the requisite powers have been conferred by the Air Ministry (Croydon Aerodrome Extension) Act of last session the work is being pressed on with. A sum amounting in all to £164,000 (largely reprovision of money voted in previous years) is provided for this purpose in the coming year.

The increase of £105,000 on the vote as a whole is attributable to the proposed expenditure at Croydon and on the Egypt—India commercial air service, but the total cost of the latter should be offset by a more than corresponding saving on other votes.

Meteorology.

The provision for meteorology in these Estimates remains practically unchanged. This does not imply any stagnation, either on the side of scientific investigation or on that of practical application; but in order to avoid an increase of expenditure the provision for routine services has had to be very strictly scrutinised.

On the purely scientific side, valuable work is being done on such subjects as atmospheric electricity, terrestrial magnetism and seismology, especially at the Kew and Eskdalemuir Observatories. It is fully recognised that the practical application of any science cannot be divorced from the study of the pure science itself.

In addition to the general forecasts which are broadcast daily as part of their ordinary programme, the British Broadcasting Company commenced during the year to issue twice daily from their high-power station at Daventry a special weather bulletin for farmers and sailors. This development of wireless telephony enables meteorology to be applied directly to the practical problems of agriculture, industry and navigation in a way which was not dreamt of before the advent of wireless.

To meet the ever increasing demands made by aviation, both service and civil, for prompt and accurate weather reports at all hours of the day and night, it has been found necessary to reorganise the forecast service at headquarters. It is now possible for an aviator, in any part of the country and at any time, to obtain within a few minutes a report on the weather conditions along any air route and a forecast of the probable changes in the course of his journey.

Air Ministry.

Vote 10 (Air Ministry) shows an increase of £10,000. This is less than the total amount of increments of pay under approved scales, without which the Vote would have shown some reduction on last year's figures. Such additions to the staff as have been found necessary (principally for technical development and equipment and for common services) have been more than set off by economies, especially in the Works and Buildings Directorate, where they have been made possible by the retardation of the building programme.

ROYAL AERONAUTICAL SOCIETY NOTICES

Lecture.—The Council of the Royal Aeronautical Society have great pleasure in announcing that Marchese de Pinedo, the Italian airman who recently flew from Italy to Australia in a Savoia seaplane, and back *via* Japan, will lecture before the Society on his experiences. The lecture will be delivered in English in the theatre of the Royal Society of Arts, on Thursday, April 8, 1926, at 6.30 p.m.

When it became known that Mr. Cobham would not be back in time to give his lecture before the Society on the date originally arranged, Flight-Lieut. H. Cooch agreed to deliver his lecture on that date. Mr. Cobham's lecture on "Long Distance Aeroplane Flights," therefore, will be delivered before the Society on March 18, 1926, at the Royal Society of Arts, 18, John Street, Adelphi, W.C. 2.

Branches.—The Council have approved of the formation of a branch of the Society at Coventry. This branch has already some 200 members. The formation of a number of other branches is now under consideration.

J. LAURENCE PRITCHARD,
Hon. Secretary.

THE AIRSHIP CLUB

A MEETING of the Committee of the Club was held at 3, Clifford Street, on February 18.

The minutes of the previous meeting were read and confirmed, and the Committee gratefully accepted the offer of Mr. Griffith Brewer to present the Club with an 80,000 C.F. Balloon.

It was decided that the balloon should be entered for the Gordon Bennett Race if found suitable after inspection, and the Club's financial liability should be limited to the entrance fee.

It was decided to accept the terms offered by Mr. B. Woodward, Solicitor, for the formation of Airship Clubs, Ltd., for £20, and that he be asked to proceed with the work forthwith.

A Sub-Committee consisting of Lieut.-Col. Lockwood Marsh, Mr. A. L. Preston, and Commander Boothby, was appointed to draw up and submit proposals to the Air Ministry for acquiring an airship, and to consider the question of a landing ground at Hendon. Lord Cunliffe was appointed to act as Assistant Hon. Secretary.

The following gentlemen were elected members:—

Lord Montagu of Beaulieu, Lieut. R. Collins, R.A.F., Messrs. B. N. Radford, Lionel Green, J. R. Cox, S. Humphries, C. Arbuthnot Lane, Charles Verner, Francis Yorke-Smith, P. C. Holmes, H. H. Morris, G. Dorman, T. H. Spottiswood.

Members who have not yet forwarded their first annual subscription are requested to do so.

F. L. M. BOOTHBY, *Hon. Secretary.*

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AIR MINISTRY NOTICES

NOTICE TO GROUND ENGINEERS

Locking of Cap on Sump Spindle of A.G.S. Petrol Filter

IMMEDIATE action should be taken to provide on all aircraft a positive lock for the cap (Pt. No. 8) on the bottom of the sump spindle (Pt. No. 4) of A.G.S. petrol filters, A.G.S. Nos. 600, 601 and 602. This is to be effected by removing the existing lock nut and sweating the cap to the sump spindle.

In cases where a drain cock or other fitting is substituted for the cap, a similar precaution must be observed.

(No. 1 of 1926.)

NOTICE TO AIRMEN

Telephone at Penshurst Landing Ground

1. THE telephone in the caretaker's hut at Penshurst landing ground (No. — Penshurst 10), which has hitherto been available for calls to certain numbers only, may now be used by pilots and also by passengers for calls to any subscriber, providing that the pilot signs the register of calls as a guarantee that his company will be responsible for payment.

2. A record of all such calls will be kept by the Civil Aviation Traffic Officer at Croydon Aerodrome, who will collect the appropriate fees from the aviation companies or individuals concerned. (No. 2 of 1926.)

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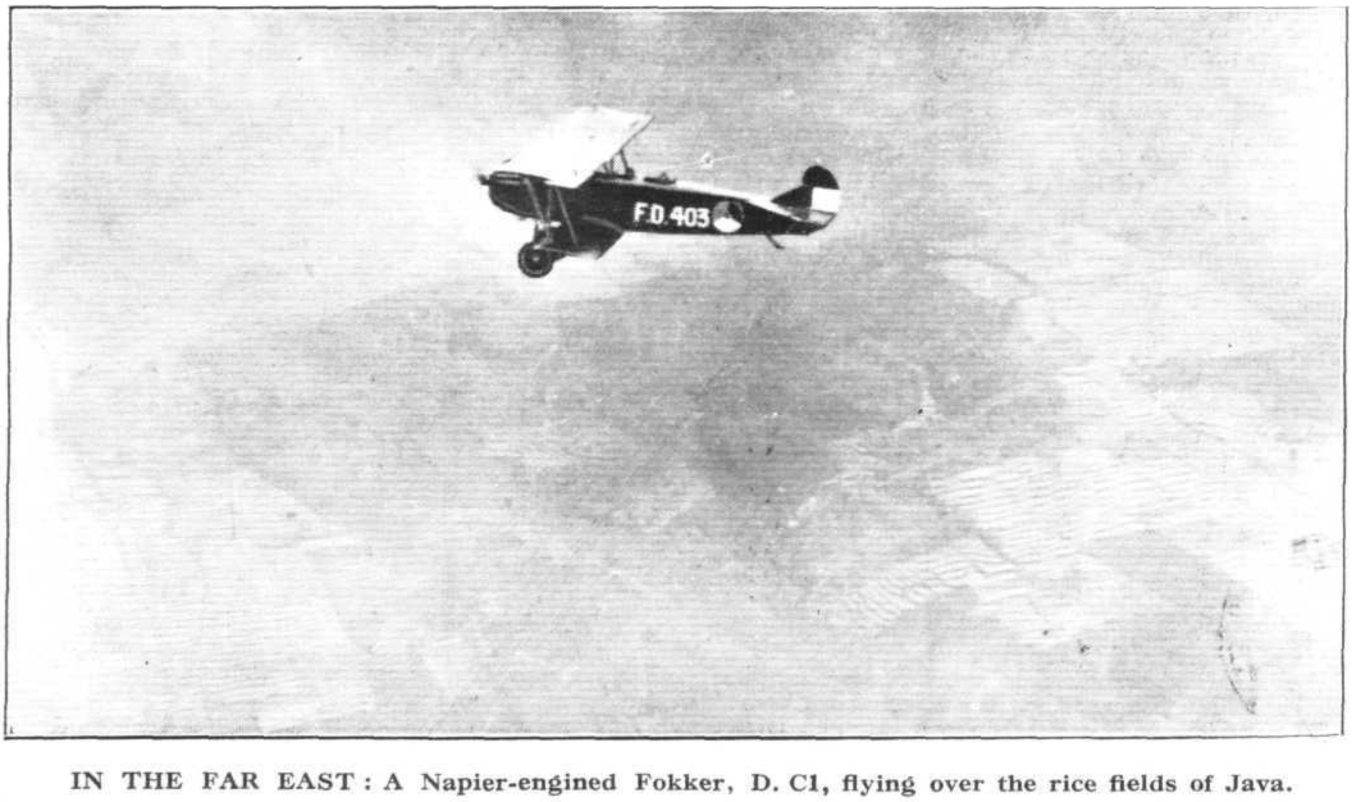
The Bristol "Jupiter" Endurance Test

THE Bristol "Bloodhound" biplane, fitted with a sealed Bristol "Jupiter" engine, which since January 4 has been carrying out a series of endurance flights between Filton (Bristol) and Croydon, is still going strong. The total number of hours flown now exceeds the 150 mark, and the total number of miles flown exceeds the distance between London and Perth, Australia, and back. We think our readers will agree that, considering that no engine replacements of any kind have been made so far, this is really a most remarkable performance. The average petrol consumption has not exceeded 22·6 gals. per hour throughout the test. The daily log of this test for the last two weeks is as follows:—February 10: Hours completed, 121 hrs. 53 mins.; mileage, 13,513. February 11: Hours completed, 126 hrs. 53 mins.; mileage, 14,068. February 13: Hours completed, 130 hrs. 10 mins.; mileage, 14,427. February 15: Hours completed, 131 hrs. 39 mins.; mileage, 14,591. February 16: Hours completed, 134 hrs. 1 min.; mileage, 14,850. February 17: Hours completed, 135 hrs. 6 mins.; mileage, 14,971. February 18: Hours completed, 143 hrs. 0 min.; mileage, 15,859. February 19: Hours completed, 151 hrs. 35 mins.; mileage, 16,813. February 20: Hours completed, 159 hrs. 55 mins.; mileage, 17,701. February 21: Hours completed, 163 hrs. 27 mins.; mileage, 18,092.

An American Polar Flight Scheme

MR. ROBERT ANDERSON POPE, a New York engineer, is organising a Polar flight to take place early this summer. The object of the expedition is to claim for the U.S. the continent supposed to exist in the unexplored region of the Arctic, and, incidentally, a flight over the Pole. It is reported that five 220-h.p. Douglas machines will be employed, and probably the pilots will include Lieuts. Leigh Wade, Lowell Smith and Ogden, who took part in the round-the-world flight, Mr. Noel Wein and Mr. Norman Read (ex-R.A.F.).



IN THE FAR EAST: A Napier-engined Fokker, D. C1, flying over the rice fields of Java.

THE ROYAL AIR FORCE

London Gazette, February 16, 1926

General Duties Branch

Flight-Lieut. M. C. Dick is granted a permanent commn. in the rank stated; Jan. 1. The following Pilot Officers are promoted to rank of Flying Officer:—H. T. Messenger; Sept. 3, 1925. N. A. West; Oct. 15, 1925. W. O. Duport; Jan. 31. J. E. Davies; Feb. 8. M. H. Jenks (Capt. Glos. Regt., R.A.R.O.); Feb. 8.

Flying Officer H. J. M. Berthon (Sub-Lieut., R.N., retd.) resigns his short service commn.; Feb. 17. Flying Officer E. C. Moon relinquishes his short service commn. on account of ill-health; Feb. 17. The short service commns. of the following Pilot Officers on probation are terminated on cessation of duty:—J. N. Goodwyn; Feb. 3. D. C. Field; Feb. 17.

Stores Branch

Flying Officer J. F. Young, M.M., is confirmed in his appt. in the Stores Branch and is granted a permanent commn. in rank stated; Feb. 17.

Medical Branch

E. J. Jenkins is granted a short service commn. as a Flying Officer for three years on the Active List, with effect from and with seny. of Feb. 1. Temp. Lieut. H. R. Peek, General List, Dental Surgeon Army, is granted a temp. commn. as Flying Officer on attachment to the R.A.F.; Feb. 1. He will continue to receive emoluments from Army funds.

Chaplains' Branch

The Rev. G. A. Davies, M.A., is granted a permanent commn. with the relative rank of Squadron Leader; Jan. 31.

Reserve of Air Force Officers

Pilot Officer A. Smith resigns his commn.; Jan. 15. Flying Officer P. T. Hubbard is transferred from Class A to Class C; Feb. 16.

London Gazette, February 19, 1926

General Duties Branch

The following Pilot Officers on probation are confirmed in rank:—R. Connor, E. J. George, S. J. Gilbert, J. D. Greaves, P. E. Grenfell, F. W. H. Hall, A. V. Harvey, A. E. Hill, F. S. Hodder, G. H. C. Ingle, W. T. Jones, H. J. F. Kempthorne, J. C. Lewis, T. K. Merrett, S. F. Prince, J. W. Stokes, D. S. Thomas, G. H. Walker, R. A. Wills, F. G. S. Wilson, J. N. Young; Jan. 18. N. S. Little; Jan. 30.

ROYAL AIR FORCE INTELLIGENCE

Appointments.—The following appointments in the Royal Air Force are notified:—

General Duties Branch

Wing Commander: A. H. S. Steele-Perkins O.B.E., to H.Q., Inland Area, for Personnel Staff duties 21.2.26.

Squadron Leaders: E. R. Pretyman, A.F.C., to H.Q., Coastal Area; 9.2.26; F. Sowrey, D.S.O., M.C., A.F.C., to No. 41 Sqdn., Northolt; 29.1.26.

Flight Lieutenants: D. R. W. Thompson, to Elec. and Wireless Sch., Flowerdown; 19.2.26. R. J. Divers, M.B.E., to R.A.F. Depot, on transfer to Home Estabt.; 12.2.26. E. Brewerton, D.F.C., to No. 440 Flight, Mediterranean; 6.2.26. J. B. P. Angel, to Aircraft Park, India; 12.2.26. R. Harrison, D.F.C., to No. 30 Sqdn., Iraq; 12.2.26. S. F. Vincent, A.F.C., to No. 2 Armoured Car Company, Palestine; 27.1.26. H. D. O'Neill, A.F.C., to Aircraft Depot, India; 12.2.26. T. S. Horry, D.F.C., to Aircraft Depot, Iraq; 12.2.26. G. R. Oliver, to No. 1 Group H.Q., Kidbrooke; 8.2.26. C. Hallawell, to Armament and Gunnery Sch., Eastchurch; 8.2.26. R. J. H. Holland, to Central Flying Sch., Upavon; 21.1.26.

Stores Branch

Flight Lieuts.: L. A. K. Butt, to the Packing Depot, Ascot; 1.2.26. A. W. Smith, to Station Commandant, Hinaidi; 24.1.26.

Flying Officers: A. G. S. Tuke, to Schl. of Tech. Training (Men), Manston; 1.2.26. B. E. Essex, to Sch. of Army Co-operation, Old Sarum; 1.2.26. H. J. Hunter, to No. 1 Sch. of Tech. Training (Apprentices), Halton; 1.2.26. W. F. Langdon, to No. 15 Sqdn., Martlesham Heath; 1.2.26. L. Horwood, M.C., to No. 100 Sqdn., Spittlegate; 1.2.26. F. B. Ludlow, O.B.E., M.C., to No. 43 Sqdn., Henlow; 13.2.26. L. L. Bray, to No. 5 Flying Training Sch., Sealand; 1.2.26. P. Alderson, to No. 2 Flying Training Sch., Digby; 1.2.26. H. D. Giblett, to No. 58 Sqdn., Worthy Down; 1.2.26. R. G. Sims to Air Ministry; 8.12.25. R. A. Dolton, to No. 39 Sqdn., Spittlegate; 8.2.26.

Pilot Officer: L. F. Caunter, to M.T. Repair Depot, Shrewsbury; 4.2.26.

NAVAL APPOINTMENTS

The following appointments were made by the Admiralty yesterday:—

Royal Air Force

Flight Lieutenant: E. Brewerton, D.F.C., to No. 440 (F. Reconn.) Flight; Feb. 6.

Fleet Air Arm

Lieutenants, R.N. (Flying Officers, R.A.F.): J. T. Robertson and E. W. E. Lane, to be attached to R.A.F. Training Base, Leuchars, during spring cruise of *Furious*; Feb. 3.

Lieutenant, E. (Flying Officer, R.A.F.): K. A. B. Hutson, to be attached to R.A.F. Training Base, Leuchars, during spring cruise of *Furious*; Feb. 3.

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IN PARLIAMENT

Flying Officers' Insurance

MR. HARRISON, on Feb. 10, asked the Secretary of State for Air whether he can now make a statement upon the question of insurance for those ranks in the Air Force whose duties necessitate their presence in flying machines?

Mr. Albery asked the Secretary of State for Air whether the Government is taking any steps which will enable flying officers to insure their lives up to a reasonable amount on terms similar to those available to officers in other branches of His Majesty's fighting services; and if any of the big insurance companies have been approached in this matter?

Sir S. Hoare: As I stated in my reply to Rear-Admiral Sueter on December 17 last, I have been in communication with the Life Offices Association, of which all important companies are members, and I am pleased to say that the negotiations with the companies have now been brought to a conclusion. Terms have been obtained from nearly 20 companies which are considerably more favourable than those hitherto obtainable, more particularly for officers of the middle and senior ranks, on whom the burden of insurance falls most heavily. In the case of a squadron leader, for example, the extra annual premium quoted to cover flying risks has been reduced from 5 guineas per cent. to 2 guineas per cent.—a reduction by more than half—and this extra premium is limited to five years instead of being payable over the whole period for which cover is desired. A small additional charge is made in some cases to cover future war risks and service abroad. An alternative method, by which the extra premium is charged on each flight subject to a fixed maximum payable in any one year and in total, has also been offered by some of the companies. Particulars of the terms offered by the companies have been brought to the notice of all officers. The scheme as at present agreed applies only to officers, but the question of its extension to other ranks in the Air Force is being taken up with the Life Offices Association.

Air Services

SIR H. BRITTAIN, on February 11, asked the Secretary of State for Air with what cities abroad we are in regular communication to-day by means of air or seaplane service; and whether any efforts are being made and, if so, in what directions, to extend this service?

Sir S. Hoare: During the winter months British air services are in regular operation abroad to Paris, Cologne (*via* Brussels), and Amsterdam; during the summer months the Paris service operates to Zurich (*via* Basle), and the Amsterdam service to Berlin (*via* Hanover). Connections exist by means of foreign air services to many of the most important cities, the number of which varies according to the season of the year. The possibility of extending British air services and of establishing other British services abroad is receiving the constant attention of the Air Ministry and of Imperial Airways, Ltd., who, under the terms of the subsidy agreement, can exercise their discretion in the matter.

Royal Air Force Recruits

MR. HORE-BELISHA asked the Secretary of State for Air (1) how many men were accepted in the year 1925 for His Majesty's Air Force; and how many were rejected on account of some physical deficiency;

(2) what percentage of applicants were rejected for the Air Force in 1925, and what the principal physical defects were, giving the proportions to the total number of rejections?

Sir S. Hoare: The number of men passed fit for service in the Air Force was 2,885; the number rejected as medically unfit was 3,414, or a percentage of 54·19 of those medically examined. The principal causes of rejection, as revealed by examination by Service medical officers, were as follows:—

	Per cent.
1. Deficient and defective teeth..	13·0
2. Diseases of the heart (valvular disease or disordered action)	12·4
3. Poor physique ..	9.5
4. Diseases of the ears ..	8·8
5. Deformities of feet ..	8·6
6. Diseases of lungs ..	8·1
7. Defects of vision ..	7·3
8. Defects of extremities ..	2·3
9. Other causes ..	30·0
	100·0

R.A.F Stations in Egypt

SIR F. WISE on February 17 asked the Secretary of State for Air how many air stations there are in Egypt; and what is the cost for 1925-26?

Sir S. Hoare: The number of Royal Air Force stations in Egypt, including Command Headquarters and repair and training establishments, is six. The estimated cost for 1925-26, including a detached flight in the Sudan, is £1,170,000.

Cairo to Cape Town Flight

LIEUT.-COMMANDER KENWORTHY asked whether the flight of the four Royal Air Force machines from Cairo to Cape Town, due to start from Egypt on or about March 1, is a preliminary to the establishment of an air-mail service to South Africa by air; and what preparations are being made to establish and develop such air-mail service?

Sir S. Hoare: The flight is being undertaken in accordance with the policy of the Air Force to make visits by air to distant parts of the Empire and to gain experience in long distance flying. At the present moment there is no intention of establishing a Royal Air Force mail service to the Cape, but I hope that the experience gained on this and other occasions may help in deciding the practicability of the operations of civil air services on these routes and linking up communications with distant parts of the Empire by air.

R.A.F. Equipment

CAPT. BOURNE asked whether any of the equipment required for the Royal Air Force is ordered from the Royal Aircraft Establishment, Farnborough?

Sir S. Hoare: Apart from the production of small numbers of instruments and accessories which have not yet been standardised for service use, no equipment for the Air Force is ordered from the Royal Aircraft Establishment, Farnborough.

Air Services and Mails

LIEUT.-COMMANDER KENWORTHY asked the Secretary of State for Air whether, in connection with the about-to-be-established air route to India, he will consider, on the one hand, the linking up of this with European mail services so as to make a continual air-mail line from Croydon to Burma; whether, on the other hand, he has examined the possibilities of extending the service by air to Australia; and if he is aware of the advantage to the trade between this country and the Dominions that would follow from an extension of the carriage of mails by air to the Dominions?

Sir S. Hoare: As regards the first part of the question, the fortnightly air service from Egypt to India and back will be timed to fit in with the arrival and departure of the mail boats, but I hope that ultimately it will be linked up with European air mail services. As regards the second part, the possibility of the extension of the service beyond India is continuously under consideration and investigation. The answer to the last part of the question is in the affirmative.

CORRESPONDENCE

The Editor does not hold himself responsible for opinions expressed by correspondents. The names and addresses of the writers, not necessarily for publication, must in all cases accompany letters intended for insertion in these columns.

THE NAVY AND THE AIR

[2123] Will you allow me to protest against one paragraph only in your leading article in your issue of to-day's date ?

"Yet it would seem that the Government, like the Navy, forgets nothing and learns nothing." The sting is only in the last two words. I don't believe it true of the average British Government, but I am not concerned with them. I do not believe that you really think it true about the Navy.

Doubtless you, when you penned the paragraph, were thinking of the Navy in relation to air works. Before the war the Navy did its share in this respect. During the war, under the administration of Mr. Winston Churchill and Lord Fisher, it did the same. It is again fully alive to the importance of air work at the present day.

Speaking generally, Great Britain may be reduced to submission in a future war. (1) By being starved. (2) By being bombed.

The first it is the duty of the Navy to prevent. The second the duty of the Royal Air Force, assisted by such diversions of the Navy and Fleet Air Arm can bring about.

In the late war we suffered from bombing, though it did not nearly drive us to submission. We did not suffer from starvation, though that was within an ace of reducing us to sue for terms.

The southern counties are therefore prone to give undue weight to the bombing danger, without considering the starvation dangers.

To prevent the latter, the Navy must be properly equipped with aircraft. When money is voted for the Fleet Air Arm, it nearly all goes to purchase flying material. Money voted to R.A.F. has to go largely into ground expenditure.

Money must be voted for both services, but it is hard to understand why the aeroplane trade and Press should try to reduce the efficiency of the Navy either in their own or the national interests. Generally, FLIGHT has been very fair on the matter, and has not joined in the campaign against the Navy being properly equipped with aircraft. This propaganda, supposedly in the interests of the R.A.F., generally takes the form of indicating the Navy, all its works, and all that belong thereto. I am sorry to see indications in the paragraph quoted that FLIGHT is not maintaining its unbiassed attitude to all departments interested in air matters.

F. L. M. BOOTHBY,
Commander, R.N. (retired).

Royal Aero Club,
February 18, 1926.

IS STEEL A HOME PRODUCT ?

[2124] I have been interested in the articles and correspondence appearing in your columns lately relating to metal construction. It seems to have been generally assumed that steel has an advantage over Duralumin in that it is a home product.

The biggest bed of iron ore in this country is, I believe, that in the Cleveland Hills, near Middlesbrough ; but it is of poor quality, and combines a low percentage of iron with a high percentage of phosphorus and sulphur. Both of these, and especially the latter, are difficult to eradicate, and are fatal to steel.

Of the pig-iron made in Middlesbrough only about one-third, I think, comes from the local ore, and the iron used in steel manufacture comes largely from the imported ore. An idea of the magnitude of iron ore imports may be gained from the fact that during the last fortnight over 113,000 tons have come into the River Tees from Spain, Scandinavia, India, North Africa, etc. ; and this at a time when only half the available blast furnaces are working. It would appear then that steel is hardly a home produce, and that Duralumin should stand or fall on its other merits.

Some of your readers more in touch with the metal trade than I am myself now may be able to confirm these impressions.

M. LANGLEY.

Southampton.
February 19, 1925.

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Junkers for S. Africa ?

COINCIDENT with Mr. Alan Cobham's demonstration of the efficiency and reliability of British aircraft comes a report that the South African Government is considering the settlement of a contract with the German Junkers firm regarding the establishment of an air mail service in the Union. With the contract is a subsidy of £80,000.

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Catalogue.

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AERONAUTICAL PATENT SPECIFICATIONS

Abbreviations **: Cyl. = cylinder ; i.c. = internal combustion ; m. = motor. The numbers in brackets are those under which the Specifications will be printed and abridged, etc.**

APPLIED FOR IN 1924
Published February 25, 1926

26,505. H. O. SHORT. Construction of thin tubular bodies. (246,598.)
26,729. LORD INVERNAIRN (W. BEARDMORE) and A. E. L. CHORLTON. Aeroplanes. (246,601.)

APPLIED FOR IN 1925
Published February 25, 1926

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The Aircraft Engineer and Airships

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